DOCUMENT RESUME

ED 233 882 SE 042 789

AUTHOR Clarkson, P. C.
TITLE Year 12 Students' Mathematical Performance on the 1980 and 1981 External Examinations. Mathematics Education Centre Report No. 25.
INSTITUTION Papua New Guinea Univ. of Technology, Lae.
REPORT NO MEC-25
PUB DATE Jan 83
NOTE 180p.; For other publications see ED 221 355 and ED 231 630.
AVAILABLE FROM The Director, Mathematics Education Centre, Papua New Guinea University of Technology, P.O. Box 793, LAE. Morobe Province, Papua New Guinea.
PUB TYPE Reports - Evaluative/Feasibility (142) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC08 Plus Postage.
DESCRIPTORS Calculus; College Mathematics; Course Content; *Course Descriptions; Foreign Countries; *Grade 12; Higher Education; High Schools; *Mathematics Achievement; Mathematics Education; *Quantitative Tests; Scores; *Secondary School Mathematics; *Test Results; Vectors (Mathematics)
IDENTIFIERS *Papua New Guinea

ABSTRACT

Descriptions of Papua New Guinea's national high schools, grade 12 major/minor mathematics courses, and an analysis of the 1980 and 1981 major/minor course examination results are presented. The analysis is intended for use by post year 12 lecturers/instructors planning their courses. Findings indicate that topic scores were far too low for these instructors to have confidence that their students have a good command of the subject matter in the year 12 syllabus. The major conclusion is that there should be a reduction in the amount of work covered in the year 12 mathematics syllabi. It is recommended that the topics of calculus and vectors be omitted from the major syllabus and that more time be spent teaching such topics as algebra, analytical geometry, and graphs/curves. If students have a better grasp of algebra and graphs, the author suggests that work now completed in the topics of calculus and vectors could be covered more quickly, and with more relevance to other aspects of mathematics, by the post year 12 lecturers. (Included in appendices are major/minor course syllabi, copies of 1980 and 1981 major/minor examinations, and a brief outline of year 10 selection procedures.) (JN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED233882

THE PAPUA NEW GUINEA
UNIVERSITY OF TECHNOLOGY

MATHEMATICS EDUCATION CENTRE

REPORT NO. 25.

YEAR 12 STUDENTS' MATHEMATICAL PERFORMANCE ON THE 1980 AND 1981 EXTERNAL EXAMINATIONS

P.C.CLARKSON

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Phil Clarkson
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

M.E.C. PUBLICATION

SE042 789

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

THE MATHEMATICS EDUCATION CENTRE

The Mathematics Education Centre is a successor of the Mathematics Learning Project set up in 1972 with the aid of the Nuffield Foundation, the R.E. Ross Trust of Victoria and other philanthropic bodies. The establishment of the Centre was made possible with aid from the British Council over the period 1978 to 1979. From 1980 the Centre has been completely funded by the University of Technology.

The brief of the Mathematics Education Centre includes a substantial commitment to educational research at all levels of the education system. In addition the Centre provides advice and assistance to tertiary level institutions, the National High Schools, the Technical Division of the Education Department and to schools in the Morobe Province.

Research projects are undertaken by members of both the Centre and the Mathematics Department of the University. Visitors from overseas are also encouraged to work at the Centre on specific projects. This occasional series reports on the work conducted by resident staff and the visitors to the Centre.

Copies of M.E.C. reports and further information about the Centre is available from :-

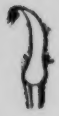
The Director,
Mathematics Education Centre,
Papua New Guinea University of Technology,
P.O. Box 793,
LAE. MOROBE PROVINCE.
Papua New Guinea.

(A list of the Reports published and other M.E.C. publications is on the last page of this Report.)

M.E.C. REPORT NO. 25

YEAR 12 STUDENTS' MATHEMATICAL PERFORMANCE ON THE 1980 AND 1981 EXTERNAL EXAMINATIONS

P.C. CLARKSON



M.E.C.
PUBLICATION

P.C. Clarkson
Series Editor
January, 1983

Published and printed by

Mathematics Education Centre Press,
Papua New Guinea University of Technology,
P.O. Box 793,
Lae,
Papua New Guinea.

CONTENTS

ABSTRACT

1. INTRODUCTION 1

1.1 The National High Schools 1

1.2 Entry to National High Schools 6

1.3 Mathematics Syllabi 8

1.4 Structure of the Final Mathematics Score of Year 12 10

2. 1980 EXAMINATIONS 12

2.1 Major Course 12

2.2 Minor Course 14

2.3 Summary 17

3. 1981 EXAMINATIONS 17

3.1 Major Course 18

3.2 Minor Course 25

3.3 Summary 32

APPENDICES 33

ACKNOWLEDGEMENTS

Thanks are due to Mrs. Helen Faunt, Senior Research Officer in the Mathematics Education Centre, for her painstaking collation of the data.

ABOUT THE AUTHOR

P.C. Clarkson, Director of Mathematics Education Centre, Papua New Guinea University of Technology. After a number of years of teaching in Victoria (Australia) secondary schools, he lectured at various State Colleges and finally at Monash University in mathematics education before joining the Mathematics Education Centre. His main writing interests have been in the areas of curriculum, spatial ability, error analysis and the art of teaching.

YEAR 12 STUDENTS' MATHEMATICAL PERFORMANCE ON THE 1980 AND 1981 EXTERNAL EXAMINATION

ABSTRACT

This report extends the analysis of the two previous Mathematics Education Centre Technical Reports Nos. 2 and 5. For the 1981 examination, detailed data is presented for individual questions.

It is hoped this will be useful for post year 12 lecturers and instructors planning their courses. The major conclusion is that there should be a reduction in the amount of work covered in the year 12 mathematics syllabi, and a more thorough treatment given of what is attempted. In particular the topics of Calculus and Vectors should be omitted from the major syllabus. This is not a criticism of the mathematics teachers in National High Schools. As is pointed out in section one, they are working under far from ideal conditions. As well many of their students have not be adequately prepared in Provincial High Schools for the National High School mathematics courses. This author thinks the time has come to face up to the fact that many students are not coming to grips with much of the material presented in year 12, and therefore a rationalisation of the course is called for.

1. INTRODUCTION

1.1 The National High Schools

The four National High Schools in Papua New Guinea are regarded as preparatory schools for university or equivalent studies. Teaching years 11 and 12, they are geared for academic training. Exit students however, are assured of a good job if they do not in fact opt for, or if they fail to qualify,for further study. These schools are without doubt the pinnacle of the school system both in terms of prestige and in the amounts of money spent on them. Figure 1 shows the location of the four schools.

Sogeri National High School is by far the oldest. It has been an educational institution of some type since the second world war. At various times it was a teacher training college, an institution running courses for various trade examinations in Queensland, and finally a Selective High School. Selective High Schools taught the New South Wales years 7 to 12 courses to national students who had been selected from across the country. In 1969 it became the first Senior High School which was later changed to National High School. The climate of Sogeri is cooler than the coast since it is situated in the foothills at the back of Port Moresby. Even though today Sogeri is only one of four National High Schools, it still seems to be regarded as the principal National High School, although this may simply be because it is near the

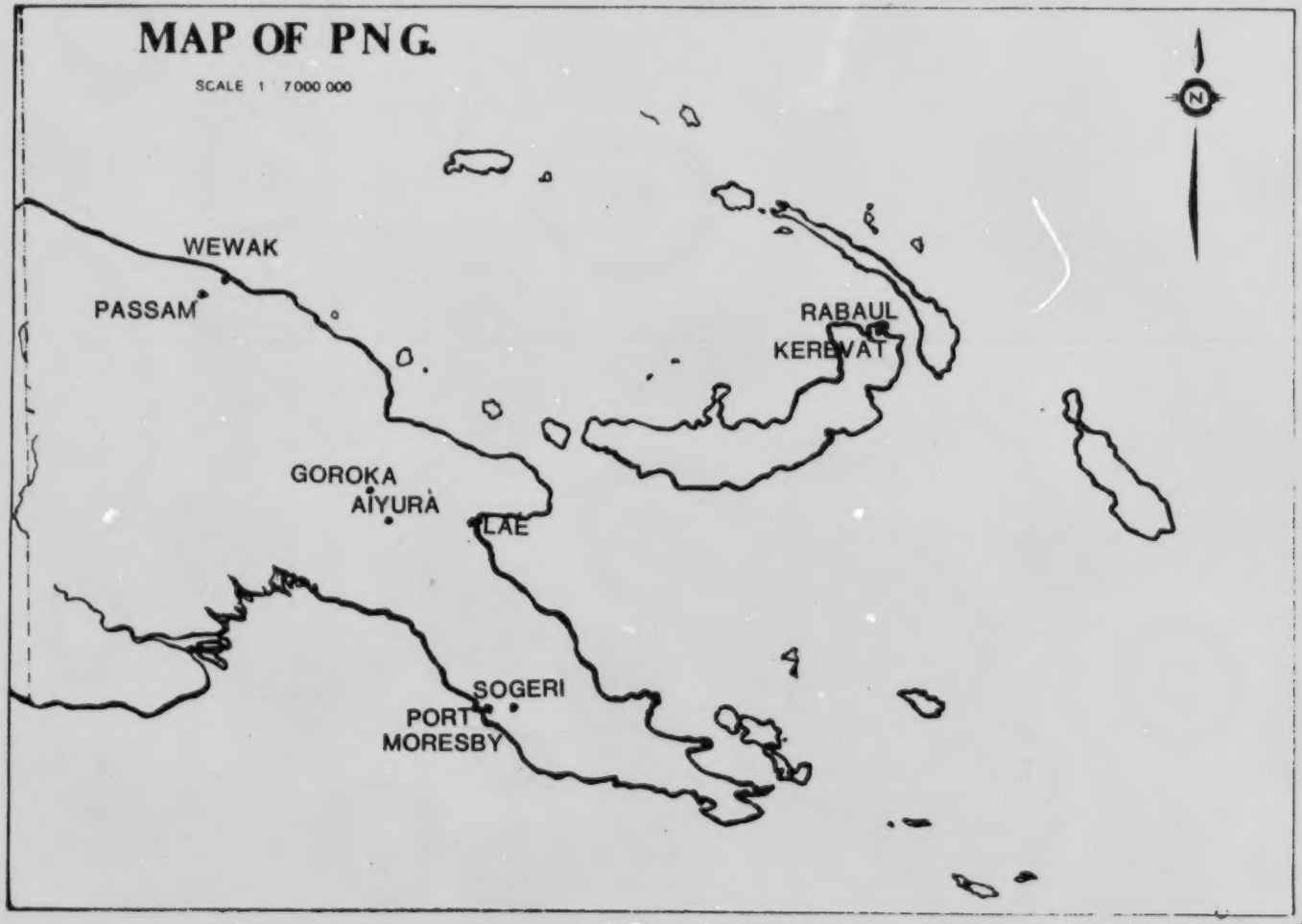


FIGURE 1 - Location of the four National High Schools.

national capital, and therefore convenient to show to visitors. This probably ensures quick and adequate supplies of resources for the school and a building program which has kept pace with its needs.

Kerevat National High School is the second oldest. This school was begun in 1961 as a Selective High School teaching years 7 to 12. In 1972 it was decided to convert the school into a National High School. From that year the lower grades were phased out. The climate is very different to Sogeri's being down on the coastal plain, and hence humid conditions often prevail. Mosquitoes are also prevalent. It seems that an adequate building program was not implemented when the up-grading took place. One gets the impression that Kerevat has always had to fight to keep up. Although Kerevat is perhaps situated in the driest area of the Gazelle Peninsula, it is reasonably near Rabaul and other beauty spots.

Aiyura National High School seems to have picked the best time to have started in 1976. Adequate money was available to ensure that a good building program for the school was implemented from the beginning, and adequate resources were allocated. Unlike its two predecessors, this school was planned from the start as a National High School with the sole aim of preparation for further study. It maybe that this ensured a little higher emphasis on academic achievement when it is compared with some of the other schools. Perhaps also, students do not have

as many distractions from larger towns, Aiyura being fairly isolated; it is a three and a half hour drive to Lae, and a two hour drive to Goroka. Being in the Highlands, the climate is often fresh and cool, although getting rather cold some nights in the unheated student dormitories.

Passam National High School started in 1978, when the financial future looked good. But, in fact, after it was planned the future did not develop as expected. Hence the building program has proved inadequate and spread over a much longer period than was desirable. This problem was evident from the beginning. The school had to start in two Provincial High Schools quite some distance apart, since buildings on site were not ready for occupation. There is still an acute shortage of staff housing. Being the newest school, resources are still being built up. The climate however is pleasant.

Virtually all staff members of the four schools are expatriates. They are recruited on three year contracts in their home countries. Although the majority are recruited specifically to teach in National High Schools, there is some movement by expatriates who have taught for one or two years in Provincial High Schools up to National Highs. Conversely there is some movement of expatriate staff to the Provincial High Schools. Hence, on average, the normal length of service of a staff member in any one National High School is less than the three year contract period. Although most recruits see out three years, the majority do not continue past their initial contract. Aiyura is perhaps the exception to this generalization.

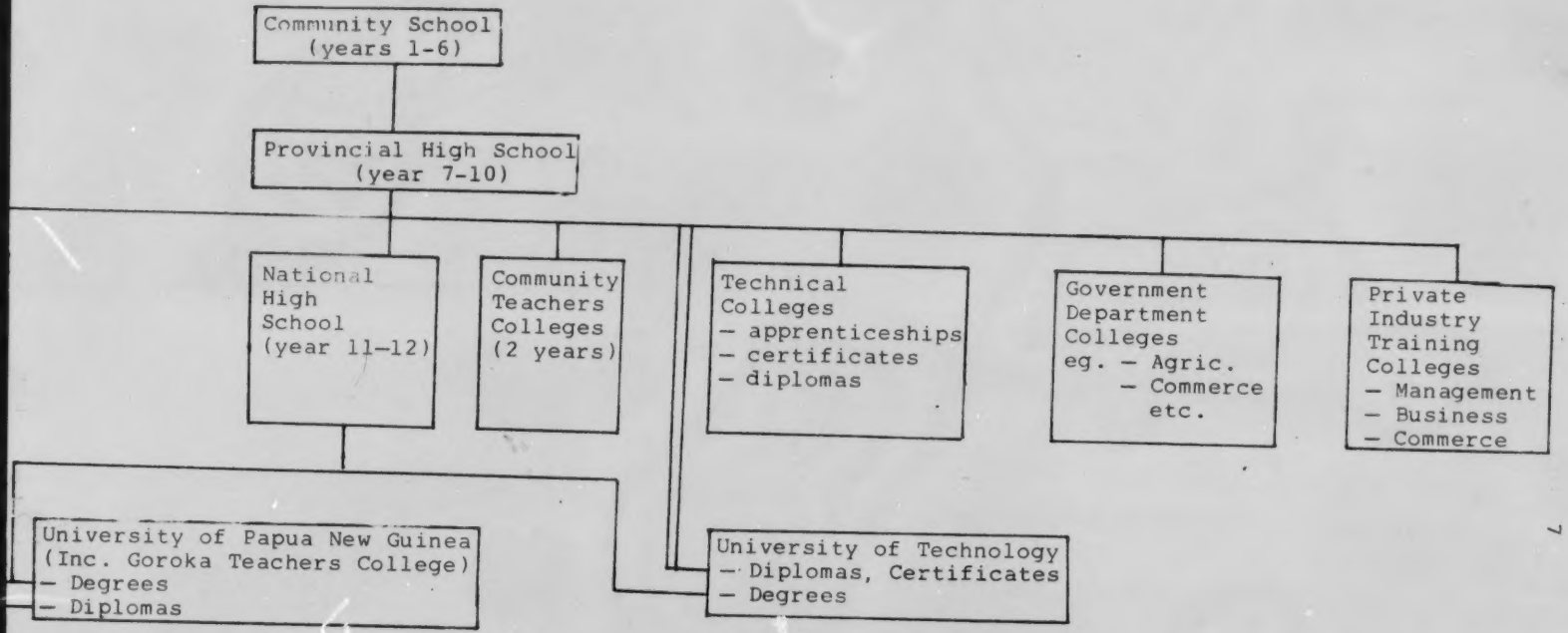
There are few national teachers in the National High Schools. In 1981 there were 8 national teachers, including one filling a deputy headmaster's position and a naturalized citizen occupying a principal's position. Of these, only one was teaching mathematics.

Most of the teachers who are recruited for National High Schools do have adequate academic qualifications. Most have some teaching experience, although this was sometimes gained in tertiary institutions, not in schools. Although a few have lived in other developing countries, notably African, virtually all of the recruits have never worked or lived in Papua New Guinea before starting to teach in a National High School. Since there is little time spent on orientation to the country or cultures, most teachers begin their careers here, teaching with the expectations and orientations they had in their home countries. It is often six months or more before a teacher starts to comprehend the real differences of teaching in this country. In particular, there is little opportunity to visit Provincial High Schools, and so the courses taught in years 11 and 12 may well be taught with little appreciation of students' previous experiences lower down in the system. To compound a new teacher's difficulties, the experience of living on a campus with boarding students, in what may well be a geographically and/or socially isolated environment, can add many pressures to his/her general living pattern.

1.2 Entry to National High Schools

Figure 2 is a schematic diagram of the education system in Papua New Guinea. Probably there are only sixty percent of children throughout the country who actually enter Community Schools. The main cut off points in the system are at the end of year 6 where sixty percent leave; at the end of year 8 where another forty percent fail to proceed: At the end of year 10 there is a ten percent failure rate in each subject. This leaves about 5,500 qualified exit students (1980 figures) from Provincial High Schools across the country. Of these it is estimated that thirty percent are unable to gain admission to any post year 10 institution.

Competition for entry to National High Schools is fierce. The main factor used in 1979 and 1980 was a student's year 10 results. These results depended in part on how well the student's school performed on a nation wide rating examination, and also on his/her own academic performance. (Appendix 1 has more details of this procedure.) A further factor in the allocation of places was the policy of ensuring a mixture of students from all provinces in any one school. So although, for example, Kerevat National High School will mainly have students from the islands, in each year's intake, at least one student from every other province will be enrolled at Kerevat. The size of the schools are more or less the same with approximately 210 entry students per year. Since few students leave before the end of year 12, there is normally about 410 students enrolled in each school.



Note: Some post year 10 colleges will give extra credits for students who have been to N.H.S.

FIGURE 2: Schematic Diagram of PNG Education's System.

1.3 Mathematics Syllabi

At year 12 there are two courses available in mathematics; the major course and the minor course. The major is intended for those students who will be studying tertiary courses heavily dependent on mathematics. The minor course is officially intended for students whose further studies are not heavily mathematically oriented. However, since it is compulsory to take one or other of the mathematics courses, the division is more often than not the brighter students opting for the major course, with the others taking the minor course.

The first common syllabi for year 12 were produced in 1976–77 to be taught in 1978. Up until then the schools virtually taught independent courses. At the end of that year a common examination for the schools was written, but it was marked at each school independently. In 1979 a common examination was again given across the schools, but this time it was marked at a central location by teachers from from the four schools, plus some representatives from tertiary institutions. It became increasingly clear that a revision of the syllabi, and greater efforts for a common interpretation of them was needed.

The major syllabus was revised in 1980 with the minor syllabus revised in 1982. In 1981 the year 11 syllabus was attended to. Since 1980, examination papers have been

externally set and marked. A system was set up in 1981 where teaching notes and sample exercises were circulated between schools. Thus in the last three years an attempt has been made to strengthen the syllabi and strive for a common interpretation of them. The remainder of this report seeks to further that move by providing some analysis of the 1980 and 1981 external examinations. Appendices 2 and 3 contain the major and minor syllabi for years 1980 and 1981. For convenience, Tables 1 and 2 give the topics for each course and the number of weeks allocated to each.

1980	1981
1. Algebra (6)	1. Probability and Statistics (6)
2. Statistics (5)	2. Algebra (7)
3. Graphs and Curves (3)	3. Graphs and Curves (3)
4. Sequences and Series (2)	4. Sequences and Series (3)
5. Trigonometry (4)	5. Trigonometry (4)
6. Vectors (2)	6. Vectors (2)
7. Analytic Geometry (3)	7. Analytic Geometry (3)
8. Rates and Change (3)	8. Calculus (3)
9. Social Mathematics (2)	

TABLE 1: Topics on the major mathematics syllabi.

1980 and 1981
1. Algebra (5)
2. Intepretation of Graphs (6)
3. Statistics (6)
4. Applied Trigonometry (6)
5. Social Mathematics (8)

TABLE 2: Topics on the minor

It should be remembered that the minor course was revised in 1982, and in the author's opinion, the revisions made have improved it immeasurably. It is hoped that in future the minor course will not be treated as a remedial course, but will be regarded as a proper year 12 subject. There are departments at tertiary level, for example the Accountancy and Business Studies Department at the University of Technology, that are prepared to take students with good grades in the minor course.

1.4 Structure of the Final Mathematics Score for Year 12

As with earlier decision points in the education system, the final score given at the end of year 12 is a combination of an external and an internal component for both the major and minor mathematic courses. The same arguments about trying to reconcile differences between schools is again used to justify this policy.

The external component of the score is gained by combining the marks students obtain on two papers sat for at the end of year 12 by simple addition. That is, the two papers are considered to be part A and part B of the one examination. The first paper consists of short answer questions, with the second made up of longer questions. Since 1980 the Director of the Mathematics Education Centre has acted as Chief Examiner for Mathematics and has had the task of producing the four external papers, two for each course.

The internal component of the final score in 1980 and 1981 was derived separately by each National High School. The manner in which this score was arrived at varied from school to school, but was based on the various assessments throughout year 12. Although it may look better to insist that the internal score is arrived at in the same manner at each school, this would probably start to impose on schools particular methods of presenting their course. It seems to this author that schools should be allowed flexibility in the methods they use to teach and to assess.

The internal and external components of the final score were combined in a 1:1 ratio, thus giving equal weighting to both components. This total score was then used to rank students within each school. The external component of the score was standardized across schools, by the Measurement Services Unit of the Education Department, and on the basis of this procedure each school was informed as to how many A's, B's, C's, D's and E's they could allocate. Allocations were then made from the rank order within each school.

In the following sections of this report the results from 1980 and 1981 will be presented in various tabulated forms. Unless stated, the results are for the whole of the year's population of year 12 students. Thus tests of significance are not needed since samples are not being dealt with. Hence differences commented on will be in the author's opinion educationally significant.

2. 1980 EXAMINATIONS

2.1 Major Course

The mean for the major course external examination (Appendix 4) was 55.87% with a standard deviation of 16.75. Although this examination was used for ranking the students and hence it is not strictly a mastery test, the rather low average does give some cause for concern.

Although the internal and external components of a student's score probably measured different aspects of mathematical ability, it would be hoped that there was a reasonable correlation between them. In fact the correlation was calculated as being 0.80.

In other countries there has been considerable interest shown in comparing the mathematical abilities of males and females, and the significant drop in the numbers of females completing higher years of school mathematics. Table 3 shows the comparison of the mean on the external scores for the sexes.

	n	%	Mean
Females	117	20.6	55.73
Males	451	79.4	55.93

TABLE 3: Comparison of mean

Although in a number of other countries males have outshone females on the final year examinations, no significant difference on these scores was found. Clearly however the number of males far exceeds females. It may well be, as in other countries, females have seen their role in life as not requiring mathematics, and only the few females who are relatively very good at mathematics remain to complete major mathematics in year 12.

A comparison of student performance across topics was also carried out. A sample of 40 papers were randomly chosen from each school, giving a total of 160 papers or 28% of the population. A useful analysis was made difficult because the second paper gave a choice of question to students, two out of eight being omitted. Further, some questions were divided into two parts, each part not necessarily testing the same topic area. Thus Table 4 only gives an indication of student performance per topic.

TOPIC	TOPIC SCORE (%)	POPULARITY (%)
Algebra	52	71(2), 53(4a)
Statistics	57	76
Graphs and Curves	55	82
Sequences	50	56(4b)
Trigonometry	57	96
Vectors	36	60(7a)
Analytical Geometry	61	96
Rates and Change	52	57
Social Maths	76	55(7b)

TABLE 4: Indicates score and popularity of topics on the major papers. (Numbers in brackets indicate

Looking at the popularity score first, it would appear that nearly all students attempted the questions on Trigonometry and Analytical Geometry, and most students chose the first question on Algebra, Statistics,and Graphs and Curves. For the sixth question the remaining topics were equally attractive. In turning to the topic scores, the score which is clearly the highest is only 76%, with all others below 61%. When students have been given a choice to leave out their hardest two questions, then higher scores might have been hoped for. Clearly the easiest topic using these scores as some guide was, not unexpectedly, Social Mathematics, and the hardest was Vectors.

2.2 Minor Course

The mean of the minor course examination (Appendix 5) was also low, 48.3%, with a standard deviation of 13.7. Again, as with the major course examination, this figure is a source of concern. The correlation coefficient comparing the internal and external components of the final score was 0.37; clearly significantly positive, but lower than hoped for.

When comparing the males and females (Table 5) there were interesting differences with the major papers. Although there were again more males, the percentages were much closer.

Female	n	%	Mean
Females	75	39.1	44.92
Males	117	60.9	50.54

TABLE 5: Comparison of mean scores between sexes for the minor course.

The comparison of scores showed the expected apparent superiority of males over females in this case.

Since choices were again given on the second paper, an analysis of student performance by topic is difficult. However a similar comparison to that carried out on the major paper was made on 100 (52%) of the minor papers.

Examining the popularity scores in Table 6 there was some disagreement in the part question scores with a total question (see Algebra and Applied Trigonometry). It's seems clear that the figures for the total questions 6 and 4 represent the truer picture of the popularity of the topics. However it is clear that most students chose both Social Mathematics questions first and the Statistics and second Algebra questions second. It seems a fair conjecture that even more students would have chosen question 1 in which two parts dealt with Algebra, except it was coupled

TOPIC	TOPIC SCORE %	POPULARITY %
Algebra	39	70(1a,b); 82(6)
Interpretation of Graphs	38	53
Statistics	62	81
Applied Trigonometry	55	70(1c); 33(4)
Social Mathematics	37	90(5); 91(7)

TABLE 6: Indicates topic scores and popularity of topics on the minor papers (Question number is given in brackets when split between topics).

with Applied Trigonometry the most unpopular topic. Perhaps the common link between the two most unpopular questions was their reliance on spatial ability.

The topic scores again indicated a low mastery of any one topic. The relatively low scores on Social Mathematics and Interpretation of Graphs was worrying, in that these topics were presumably included in this course to make it more relevant for this type of student. At least some grasp of Statistics was shown.

2.3 Summary

Clearly the results from both courses were disappointing. It is acknowledged that these examinations formed the basis for a process of ranking students, and were not in themselves mastery tests. However, the average marks for all topics except one were below 61%, and this when choices had been given on the papers. Concern is heightened when it has been reported that the heads of the department of mathematics in the schools were satisfied that overall the papers were fair assessment instruments. Clearly there was a lot of mathematics the year 12 students of 1980 had not come to grips with.

3. 1981 EXAMINATIONS

Two important changes occurred during 1981 which prevents a direct comparison of the 1980 and 1981 results. Firstly it was decided that no choices would be given on paper two, the paper which consisted of longer questions. Secondly, the major syllabus had been revised in 1980 and taught in 1981. Although there was a number of changes, there existed quite a degree of overlap between the two syllabi, thus it will be possible to deduce some trends across the two years. Finally during 1982 extra facilities were available at the Mathematics Education Centre for this project, and a more extensive analysis was carried out on the results.

3.1 Major Course

The two external papers for this course comprise Appendix 6. The mean of the total score from the two papers was 44.8 with a standard deviation of 14.8. As with the 1980 examination, this average was rather low. The correlation between the internal and external components of the final score was 0.81, a rather satisfactory situation.

A comparison of males and females shows there was little difference in performance which follows the same trend as 1980 (see Table 7). However there were certainly fewer females attempting the major course in 1981 than 1980.

Females	n	%	Mean
Females	92	15.8	43.01
Males	489	84.2	45.22

TABLE 7: Comparison of mean scores between sexes for the major course.

Table 8 gives a percentage score for each topic. In 1981 'Vectors' was clearly the hardest topic.

TOPICS	%
1. Probability and Statistics	47.4
2. Algebra	46.5
3. Graphs and Curves	53.9
4. Sequences and Series	35.9
5. Trigonometry	39.2
6. Vectors	29.5
7. Analytical Geometry	51.5
8. Calculus	33.4

TABLE 8: Topic scores on the major papers.

In trying to locate trends from 1980 to 1981 there are some difficulties which need to be considered. Firstly, there was a change in the syllabus which meant some changes to the content, although these were not extensive. Rather a reorganization took place. Secondly, there was no choice allowed on the long question paper as there had been in 1980. And thirdly, some topics were predominantly examined by one question. The style of question must be examined before comparisons are made. However given the above, some general comments can still be made. It seems that students are simply not coping with 'Vectors' at all. 'Sequences and Series' also seems to have been a hard topic in both years with 'Calculus' not far behind. On the other hand, 'Analytic Geometry' and 'Statistics' seem to have been handled better.

Tables 9 and 10 give the results by question for both papers.

Question	Total	Mean Score	% of Students Gaining Full Marks	% of Students Gaining Zero Marks	Topics
Section A - 1	1	0.67	67.4	32.6	2
2		0.93	92.7	7.3	2
3		0.72	72.1	27.3	1
4		0.12	12.1	87.9	1
5		0.10	10.0	90.0	8
6		0.74	74.0	26.0	4
7		0.69	68.8	31.2	3
8		0.83	83.2	16.8	2
9		0.84	84.2	15.8	2
10		0.76	76.1	23.9	1
Section B-11	2	0.32	8.2	76.1	2
12		1.59	72.6	14.3	1
13		0.93	27.0	30.1	8
14		0.93	0.38	9.4	5
15		1.24	59.5	34.9	3
16		1.32	63.0	29.5	3
17		1.53	75.0	22.2	5
Section C-18	3	1.68	46.4	30.6	2
19		0.74	19.7	68.6	1
20		2.36	53.9	2.9	1
21		1.08	15.6	44.3	8
22		0.97	16.0	53.8	4
23		1.70	45.3	36.0	2
24		1.07	19.9	43.9	5
25		0.68	13.1	59.7	2

TABLE 9: Results by question on the short answer paper of the major course.

Question	Total	Mean Score	% of Students Gaining Full Marks	% of Students Gaining Zero Marks	Topic
1 (a)	2	1.53 (76.5)	64.0	13.5	2
(b)	4	0.86 (21.5)	0.4	28.3	
(c)	2	0.71 (35.5)	17.3	45.3	
Total	8	3.21 (40.1)			
2 (a)	1	0.59 (59.4)	59.4	39.9	7
(b)	2	1.43 (71.5)	74.4	20.8	
(c)	5	2.09 (41.8)	23.5	34.9	
Total	8	4.26 (53.3)			
3	6	1.59 (26.5)	7.1	42.8	5
4	6	1.77 (29.5)	5.2	45.5	6
5	5	2.13 (42.6)	4.6	4.0	3
6 (a)	3	1.79 (59.7)	46.6	25.0	8
(b)	4	0.68 (17.0)	5.0	64.0	
Total	7	2.58 (36.9)			
7	7	2.23 (31.9)	3.8	32.6	1
9 (a)	3	1.03 (34.3)	16.0	36.2	4
(b)	2	0.48 (24.0)	30.8	71.7	
Total	5	1.57 (31.4)			

TABLE 10: Results by question on the long answer paper by the major course.

No generalizations will be drawn from these tables. The importance of this data is the insights it can potentially give lecturers and instructors of post year 12 courses into the detail of particular aspects of the major mathematics course which students do or do not know. Such detail is lost when only topic scores are available.

The final comparisons made on the major results are those relating to the performance of the sexes. Table 11 compares

TOPIC	MALE %	FEMALE %
Probability and Statistics	46.9	48.9
Algebra	45.9	48.2
Graphs and Curves	52.4	58.8
Sequences and Series	35.7	36.4
Trigonometry	39.1	39.6
Vectors	30.5	26.3
Analytical Geometry	51.0	53.0
Calculus	32.9	35.1

TABLE 11: Topic scores of males and females on major course.

males and females across the topics on the syllabus. The only real difference on this data was for the topic of 'Graphs and Curves' where the females performed a little better. Tables 12 and 13 compare males and females on the individual questions. The indicator of significance was a difference of ten percent in the mean score. Interestingly the females out performed males on this criteria. It would be nice to be able to explain these differences by reference to reading ability, at which females tend to be better, or to visual-spatial ability where the males tend to have a better performance. However no such explanations seem to suffice for this data.

Question	Total	MALE			FEMALE			Male or Female
		Mean Score	% Students Gaining Full Marks	% Students Gaining Zero Marks	Mean Score	% Students Gaining Full Marks	% Students Gaining Zero Marks	
1	1	0.67	66.6	33.4	0.70	70.3	29.7	
2		0.92	92.0	8.0	0.95	94.9	5.1	
3		0.75	74.6	25.4	0.64	63.6	36.4	M (1)
4		0.13	13.0	87.0	0.09	9.3	90.7	
5		0.09	8.5	91.5	0.15	15.3	84.7	
6		0.72	71.6	28.4	0.82	82.2	17.8	F (4)
7		0.68	67.8	32.2	0.72	72.0	28.0	
8		0.82	81.8	18.2	0.88	88.1	11.9	
9		0.84	83.8	16.2	0.84	85.6	14.4	
10		0.77	77.1	22.9	0.73	72.9	27.1	
11	2	0.29	7.2	77.1	0.39	11.8	72.9	
12		1.58	72.3	14.7	1.61	73.7	12.7	
13		0.92	25.7	31.7	0.97	31.4	24.6	
14		0.92	0.5	10.5	9.94	0.0	5.9	
15		1.21	57.9	36.4	1.36	65.3	29.7	
16		1.27	60.1	33.1	1.48	72.9	17.8	F (3)
17		1.53	74.8	21.9	1.53	75.4	22.9	
18	3	1.64	44.9	32.9	1.82	51.7	34.3	
19		0.72	19.0	23.0	0.81	22.1	23.0	
20		2.35	54.4	5.3	2.40	52.5	1.3	
21		1.13	17.7	43.1	0.92	8.5	48.3	
22		1.00	16.5	55.4	0.88	14.4	48.3	
23		1.73	45.4	39.9	1.61	44.9	33.1	
24		1.04	18.5	43.1	1.11	24.6	46.6	
25		0.62	11.5	62.1	0.86	18.7	51.7	

TABLE 12: Results by question comparing sex on the short answer paper of the major course.
The last column indicates the 'better' performance.
The bracketed number indicates the topic.

Question	Total	MALE			FEMALE			Male or Female
		Mean Score	% Students Gaining Full Marks	% Students Gaining Zero Marks	Mean Score	% Students Gaining Full Marks	% Students Gaining Zero Marks	
1(a)	2	1.51	66.3	13.5	1.60	73.7	13.6	
(b)	4	0.83	0.2	27.7	0.97	0.8	30.5	
(c)	2	0.71	17.5	45.1	0.68	17.0	37.3	
Total	8	3.04			3.79			
2(a)	1	0.59	59.4	40.6	0.59	59.3	40.7	
(b)	2	1.40	74.1	20.4	1.54	75.4	22.0	
(c)	5	2.09	24.2	35.2	2.11	21.2	33.9	
Total	8	4.08			4.95			F (7)
3	6	1.60	6.5	41.9	1.60	9.3	45.8	
4	6	1.83	5.2	44.4	1.58	5.1	45.8	
5	5	2.08	4.8	4.3	2.32	3.4	3.4	
6(a)	3	1.75	45.6	24.3	1.92	50.0	20.3	
(b)	4	0.67	4.5	64.4	0.72	6.8	62.7	
Total	7	2.42			3.19			F (8)
7	7	2.14	4.3	33.7	2.53	2.5		
8(a)	3	1.02	15.7	36.7	1.08	17.0		
(b)	2	0.47	33.9	72.1	0.50	20.3		
Total	5	1.50			1.84			

TABLE 13: Results by question comparing sex on the long answer paper of the major course.
The last column indicates the 'better' performance.
The bracketed number indicates the topic.

3.2 Minor Course

Appendix 7 contains the two external papers for this course. The mean of the total score from the papers was 47.7% with standard deviation of 12.4. Again the average is low. The correlation between the internal and external components of the final score was 0.61. Over both years this correlation has been on the low side, but certainly the 1981 figure is an improvement on the 1980 figure of 0.37.

A comparison of the performance of males and females is shown in Table 14.

	n	%	Mean
Females	69	33.2	45.87
Males	139	66.8	48.62

TABLE 14: Comparison of mean scores between sexes on the minor course.

Unlike 1980 there is no significant difference between the two groups. Again, like the major course, the percentage of females attempting this course was also down, reflecting the drop in the number of females in year 12 in 1981.

In turning to the topic scores, a comparison across the years is a little easier since there was no syllabus change. However, there was the problem of no choice on the long answer question paper in 1981. However, it seems clear from Tables 6 and 15 that 'Algebra' was the problem topic

TOPICS	%
1. Algebra	32.5
2. Interpreting Graphs	45.3
3. Statistics	59.1
4. Trigonometry	47.2
5. Social Maths	60.7

TABLE 15: Topics scores on the minor papers.

with 'Statistics' seeming to be easier. 'Social Mathematics' was the topic which changes its rank position dramatically. Probably the explanation for this is that in 1980 two long questions examined this topic, which virtually all students attempted, with a few short answer questions on paper A. In 1981 there was only one long question, which students had to answer, but many more short answer questions, which on the whole prove easier for students.

Tables 16 and 17 give the results by question for both papers.

Question	% Students Gaining Full Marks	Topic	Question	% Students Gaining Full Marks	Topic
1	89.5	5	26	14.8	yr. 11
2	13.3	3	27	58.6	yr. 11
3	13.3	2	28	7.1	1
4	32.4	4	29	57.6	1
5	81.0	2	30	17.1	4
6	57.1	2	31	20.5	4
7	33.3	4	32	51.9	4
8	2.4	1	33	71.4	1
9	58.1	2	34	45.7	4
10	86.7	5	35	38.6	1
11	14.8	5	36	64.3	5
12	26.2	5	37	9.0	yr. 11
13	13.8	1	38	41.0	4
14	76.2	5	39	18.6	yr. 11
15	19.5	1	40	35.7	4
16	50.5	5	41	55.2	3
17	36.2	1	42	63.8	2
18	41.4	2	43	75.2	yr. 11
19	66.7	5	44	62.9	3
20	51.4	5	45	26.2	3
21	33.3	5	46	55.7	5
22	54.8	5	47	32.9	5
23	43.8	2	48	21.9	5
24	88.6	2	49	69.5	1
25	41.9	3	50	0.0	yr. 11

TABLE 16: Results by question on the short answer paper of the minor course. (Each question scored 1 mark).

Question	Total	Mean Score	% of Students Gaining Full Marks	% of Students Gaining Zero Marks	Topic
1(a)	5	2.56 (51.2)	1.9	6.7	2
(b)	1	0.08 (7.6)	7.6	92.4	
(c)	1	0.09 (9.0)	9.0	91.0	
(d)	1	0.26 (26.2)	26.2	73.8	
Total	8	2.98 (37.2)			
2	7	3.52 (50.3)	12.7	13.8	4
3	5	3.00 (59.9)	43.8	17.1	4
4	10	6.67 (66.7)	10.5	1.4	3
5	9	7.18 (79.8)	12.9	0.5	5
6(a)(i)	3	1.73 (57.8)	39.0	11.4	1
(ii)	4	0.64 (16.0)	1.9	51.4	
6(b)	4	1.05 (26.3)	1.9	30.5	
Total	11	3.33 (30.2)			

TABLE 17: Results by question on the long answer paper of the minor course.

As with the major course, no generalizations will be drawn. The results are presented for those who are teaching post year 12 mathematics courses.

Turning to a comparison of the performance of males and females, Table 18 shows

TOPICS	MALES %	FEMALES %
1. Algebra	32.6	32.2
2. Interpreting Graphs	46.0	44.5
3. Statistics	58.3	60.2
4. Trigonometry	49.1	38.9
5. Social Maths	63.2	57.2

TABLE 18: Topic scores of males and females on the minor course.

this across topic areas. The males clearly out perform the females on 'Trigonometry' and do better on 'Social Mathematics'. Tables 19 and 20 make the same comparison for individual questions. It would seem that the males' better performance on the long trigonometry question was most influential in their overall higher performance on this topic, but in social mathematics it was the shorter questions which led to their better performance.

QUESTION	MALES % SCORE	FEMALES % SCORE	MALES OR FEMALES	QUESTION	MALES % SCORE	FEMALES % SCORE	MALES OR FEMALES
1	90.1	88.6		26	14.8	14.8	
2	9.0	19.3	F(3)	27	63.1	52.3	M(yr.11)
3	13.9	12.5		28	4.1	11.4	
4	35.2	28.4		29	56.6	59.1	
5	87.7	71.6	M(2)	30	17.2	17.0	
6	60.7	52.3		31	20.5	20.5	
7	32.8	34.1		32	50.8	53.4	
8	2.5	2.3		33	76.2	64.8	M(1)
9	59.0	56.8		34	54.1	34.1	M(4)
10	86.9	86.4		35	35.2	43.2	
11	19.7	8.0	M(5)	36	66.4	61.4	
12	31.1	19.3	M(5)	37	9.0	9.1	
13	14.8	12.5		38	34.4	50.0	F(4)
14	77.0	75.0		39	19.7	17.0	
15	19.7	19.3		40	36.1	35.2	
16	59.0	38.6	M(5)	41	61.5	58.0	
17	40.1	30.7		42	48.4	37.5	
18	42.6	39.8		43	63.1	64.8	
19	72.1	59.1	M(5)	44	73.8	47.7	M(3)
20	56.6	44.3	M(5)	45	30.3	20.5	
21	36.1	29.5		46	60.7	48.9	M(5)
22	59.0	48.9	M(5)	47	44.3	17.0	M(5)
23	38.5	51.1	F(2)	48	23.8	19.3	
24	89.3	87.5		49	66.4	73.9	
25	46.7	35.2	M(3)	50	0.0	0.0	

TABLE 19: Results by question comparing sex on the short answer paper of the minor course.
The last column indicates 'better' performance.
The bracketed number indicates the topic.

QUESTION	TOTAL	MALES			FEMALES			MALES OR FEMALES
		Mean Score	% Students Gaining Full Marks	% Students Gaining Zero Marks	Mean Score	% Students Gaining Full Marks	% Students Gaining ZeroMarks	
1(a)	5	1.50	2.5	6.6	1.1	1.1	6.8	
(b)	1	0.08	8.2	91.8	0.1	6.8	93.2	
(c)	1	0.08	8.2	91.8	0.1	10.2	89.8	
(d)	1	0.22	22.1	77.9	0.3	31.8	68.2	
Total	8	2.95			3.0			
2	7	3.84	13.9	13.9	3.1	11.4	13.6	M(4)
3	5	3.15	45.1	25.0	3.1	42.0	15.9	
4	10	6.52	11.5	1.6	6.9	9.1	1.1	
5	9	6.71	18.9	0.8	6.7	23.9	1.1	
6(a)(i)	3	1.75	41.0	13.1	1.7	36.4	9.1	
(ii)	4	0.68	1.6	48.4	0.6	2.2	55.7	
6(b)	4	1.11	3.3	30.3	1.0	0.0	30.7	
Total	11	3.37			3.3			

TABLE 20: Results by question comparing sex on the long answer paper of the minor courses.
The last column indicates 'better' performance.
The bracketed number indicates the topic.

3.3 Summary

As in 1980, the topic scores in 1981 were low, far too low for these students' future teachers to have confidence that they had a good command of the subject matter in the year 12 syllabi. The topics of 'Vectors' and 'Calculus' were of particular concern in the major syllabus. Not only were the marks low for these two topics, but an examination of the syllabus reveals that both topics give only a rudimentary introduction to these areas of mathematics. It may well be better to delete these two topics from the syllabus altogether and spend more time especially on 'Algebra' and perhaps on 'Analytical Geometry', and 'Graphs and Curves'. In singling out these topics for extra time, the author is mindful of the rather late beginning made on these topics in Provincial High Schools. The prerequisite ideas for 'Algebra' are only presented in year 9. Thus Papua New Guinean students simply have not had time to complete the many examples in algebraic manipulations that western students have completed by the time they are introduced to 'Calculus and 'Vectors'. If post year 12 students had a better grasp of algebra and graphs for example, the author suspects that the work now completed in the topics 'Calculus' and 'Vectors' at year 12 could be covered far more quickly, and with more relevance to other aspects of mathematics, by the post year 12 lecturers.

APPENDICES

1. Year 10 selection procedures 34

2. Major Mathematics Syllabus 36

3. Minor Mathematics Syllabus 47

4. 1980 Major external papers 55

5. 1980 Minor external papers 81

6. 1981 Major external papers 112

7. 1981 Minor external papers 134

APPENDIX 1

Year 10 selection procedures.

An extract from a letter by E.J. Bannister, Senior Projects Officer, Office of Higher Education, 8/10/82.

"In 1979 and 1980 final Gr. 10 assessments were derived as follows:-

1. In July, Grade 10's sat for a nationwide "rating" or school moderating exam.

2. On the basic of this exam alone, each school was advised of how many distinctions, credits, etc. it may award to its students at the end of the year. The results of this examination were not included in individual student assessments (although a few schools may have done so unofficially).

3. Over the years, the percentages of the various grades awarded nationally has varied, but in 1979 – 80 it remained steady at 5% Distinctions, 25% Credits, 25% and Upper Passes 25%.

4. After July, continuous internal assessment continued for the Grade 10's until the end of October, by which time the students would have had a "standardised" score obtained over Grade 9 and Grade 10, with Grade 10 assessments having a heavier weighting.

5. About this time of the year, the National Department of Education sent out a variety of examination questions to schools. These questions were divided into groups. The schools selected a certain number of questions from each group to make up their own exam papers.

6. The results of this examination were given a weighting of 25% and the cumulative internal assessment 75% to obtain a final score for each student.

7. The students were then ranked within the school and distinctions, credits, etc. counted off as per the official advice from the July ratings exam".

APPENDIX 2

MAJOR MATHEMATICS SYLLABUS

CONTENTS

			Page
12.1	PROBABILITY & STATISTICS	(6 Weeks)	3
12.2	COMPUTER APPRECIATION	(1 Weeks)	5
12.3	ALGEBRA	(7 Weeks)	6
12.4	GRAPHS AND CURVES	(3 Weeks)	7
12.5	SEQUENCES AND SERIES	(3 Weeks)	8
12.6	TRIGONOMETRY	(4 Weeks)	9
12.7	VECTORS	(2 Weeks)	10
12.8	ANALYTIC GEOMETRY	(3 Weeks)	11
12.9	INTRODUCTION TO CALCULUS	(3 Weeks)	12

TOTAL TEACHING TIME = 32 WEEKS

12.1 PROBABILITY & STATISTICS (6 WEEKS)

OBJECTIVES		CONTENT
12.1.1	Calculate relative frequency	Variety of practical examples e.g. coins, cards, dice
12.1.2	Calculate theoretical probabilities	Coins, cards, dice, children $P(E) = \frac{N(E)}{N(S)}$ Tree diagrams Meaning of $P(E) = 0$ or $P(E) = 1$ Exclude conditional probability Ref: CLARKE ch. 24
12.1.3	Distinguish between discrete and continuous data.	Frequency polygons and curves. Grouped data Frequency tables Class boundaries Mid-interval values
12.1.4	Determine measures of central tendency and spread.	Mode, modal class, mean, (assumed mean), median Range and spread
12.1.5	Draw and use cumulative frequency diagrams	Percentiles, (semi-)interquartile range, estimated median, concept of percentage below/above.
12.1.6	Calculate standard deviations	Concentrate on $\sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n}}$ with a few $\sigma = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \frac{(\Sigma fx)^2}{(\Sigma f)}}$

12.1.7	Recognize the normal distribution curve and interpret it	% for $\pm$ 1, 2, 3, s.d.'s from the meaning. Contrast with other distributions
12.1.8	Correlate 2 sets of data	Scatter diagrams Regression lines a) by eye b) through mean Ref: GREER ch. 37 CLARKE ch. 22

12.2 COMPUTER APPRECIATION (1 WEEK)

	OBJECTIVES	CONTENT
12.2.1	Know what a computer is and how it developed	Abacus, slide rule, ... post-war developments Mention memory and programability Ref: S.C.S.P. series
12.2.2	Appreciate where and how computers are used in PNG	Films, speakers, visits Types of print-out
12.2.3	Interpret and construct simple flow charts	Symbols Concentrate on interpretation
12.2.4	Gain some experience in using equipment	

12.3 ALGEBRA (7 WEEKS)

	OBJECTIVES	CONTENT
12.3.1	Simplify, factorize, solve simple equations, manipulate formulae	Revision of grade 11 work Ref: GREER ch. 8, 9, 10, 11, 12 CLARKE ch. 9,10,11,12 Profit, loss, discount, simple interest Ref: GREER ch. 4, 5 CLARKE ch. 6, 7
12.3.2	Solve simultaneous equations	Solve by elimination, substitution, Ref: GREER ch. 13, 16, ex. 51 CLARKE ch. 11, 12, ex. 12.5b
12.3.3	Solve quadratic equations	Solve graphically, by factorizing and by formula (not completing the square) Use discriminant to determine nature of roots Ref: GREER ch..16 CLARKE ch. 12
12.3.4	Perform simple divisions of polynomials	Division by linear expressions
12.3.5	Use remainder and factor theorems	Find remainders Find factors. Solve polynomial equations up to degree 4 Use function notation Ref: CLARKE pg. 95 & 96

12.4 GRAPHS AND CURVES (3 WEEKS)

OBJECTIVES		CONTENT
12.4.1	Plot, and in simple cases sketch without plotting, linear, quadratic, circular, exponential, hyperbolic graphs	$ax + by + c = 0$ $y = ax^2 + bx + c$ $y = a/x$ $x^2 + y^2 = a^2$ $y = 2^x$, $y = 10^x$ (not e^x)
12.4.2	Select an appropriate equation given a sketch graph.	As above
12.4.3	Draw and interpret inequality relations	As above
12.4.4	Solve simultaneous equations and inequations graphically	As above
12.4.5	Find the law of a straight line from experimental data.	Hookes Law, simple machines, Ohms Law, etc. Use realistic data Ref: GREER ch. 18 CLARKE ch. 13, 14

12.5 SEQUENCES AND SERIES (3 WEEKS)

OBJECTIVES	CONTENT
12.5.1 Understand the concepts: sequence and series	Notation: T_n, S_n, Use a wide variety of sequences and series.
12.5.2 Use arithmetic progressions	$T_n = a + (n-1)d$ $S_n = \frac{n}{2}\left[2a + (n-1)d\right]$ and apply arithmetic mean
12.5.3 Use geometric progressions	$T_n = ar^{n-1}$ $S_n = \frac{a(r^n - 1)}{r - 1} = \frac{a(1 - r^n)}{1 - r}$ $S_\infty = \frac{a}{1 - r}$ Geometric mean Applications including compound interest, exponential growth/decay Ref: GREER ch. 38 & 39 CLARKE ch. 7, 17

12.6 TRIGONOMETRY (4 WEEKS)

OBJECTIVES		CONTENT
12.6.1	Understand right-angled triangles	Sine, cosine, tangent Pythagoras Ref: GREER ch. 28
12.6.2	Use angles of any magnitude and find the values of their trig. functions.	Sine, cosine and tangent of positive and negative angles Graphs and periodicity.
12.6.3	Use the sine and cosine rules to solve triangles	Exclude the ambiguous case. Practical problems Ref: GREER ch. 29
12.6.4	Radian measure	The idea of a radian Conversions: degrees ↔ radians Sin, cos, tan of angles given in radians. Arc length and area of sector formulae Application Ref: CLARKE Pg. 439

12.7 VECTORS (2 WEEKS)

	OBJECTIVES	CONTENT
12.7.1	Differentiate between a vector and a scalar	Magnitude, direction, distance displacement, velocity, speed, acceleration, force
12.7.2	Illustrate vectors using directed line segments	Displacement, velocity, force Notation: OA, $\underline{a}$ $\lvert\overrightarrow{OA}\rvert$ = OA, $\lvert\underline{a}\rvert$ = a
12.7.3	Add and subtract two physical vectors	Triangle law with applications with and without scale drawing e.g. forces and navigation Ref: GREER ch. 32
12.7.4	Use unit vectors	Define $\underline{i}$ and $\underline{j}$ (not $\underline{k}$) Addition, subtraction and scalar multiplication of vectors in component form.

12.8 ANALYTIC GEOMETRY (3 WEEKS)

	OBJECTIVES	CONTENT
12.8.1	Find the distance between two points.	Derive the formula and apply
12.8.2	Find the mid-point of an interval	Derive the formula and apply
12.8.3	Find the gradient of a straight line.	Derive the formula and apply. Conditions for parallel and perpendicular lines.
12.8.4	Use the equation of a straight line.	$y = mx + c$, $ax + by + c = 0$ Find equation given a) two points b) one point and gradient and applications Ref: BOSTOCK ch. 4

12.9 INTRODUCTION TO CALCULUS (3 WEEKS)

OBJECTIVES		CONTENT
12.9.1	Interpret graphs	Distance-time and velocity-time graphs
12.9.2	Understand gradients	Gradient of straight line Gradient of a secant of a curve e.g. average velocity, acceleration
12.9.3	Idea of a limit	Instantaneous velocity and acceleration $\lim_{\delta x \to 0} \frac{f(x + \delta x) - f(x)}{\delta x}$ Differentiate from first principles, linear and quadratic functions.
12.9.4	Differentiate simple polynomial functions by rule.	Emphasis on linear and quadratic functions Ref: GREER Ex. 68 - 71, pg. 149

APPENDIX 3

MINOR MATHEMATICS
YEAR 12

UNIT 12.11 ALGEBRA (5)
UNIT 12.12 COMPUTER STUDIES (4)
UNIT 12.13 INTERPRETATION OF GRAPHS (6)
UNIT 12.14 STATISTICS (6)
UNIT 12.15 APPLIED TRIGONOMETRY (6)
UNIT 12.16 SOCIAL MATHEMATICS (8)

THE NUMBERS IN BRACKETS INDICATE THE APPROXIMATE TIME NEEDED TO TEACH THE UNITS, THE TOTAL TIME SUGGESTED IS 35 WEEKS.

NOTE: This edition will not be used after 1982.

UNIT 12.11

INTRODUCTION

This unit is designed to consolidate the basic algebra concepts presented in the Grade 11 course.

Mathematical principles are largely founded on algebraic operations. To ensure that students are equipped to study the subject at any higher level it is essential that a clear understanding of basic algebra is achieved.

OBJECTIVES	CONTENT
When students have completed this unit they should be able to:-	
12.11.1-Solve simple linear equations in one unknown.	Of the type:- $8x = 96$; $2c + 1.6 = 3.4$; $3e + 15 = e + 25$; $2(r - 1) = 10$; $z + \frac{3z}{4} = 28$; $\frac{x-5}{10} + \frac{x+5}{5} = 5$. The sum of the angles of an n-sided polygon is (2n-4) right angles; find the number of sides of a polygon if each angle is 108°.
12.11.2- substitute values into expressions and formulae and to accurately evaluate same.	Evaluation of formulae and expressions using given values. $3x^2y$, $\frac{a}{3} + \frac{b}{7}$; $K.E. = \frac{1}{2}mv^2$; $P_1 = \frac{P_2 V_2 T_1}{V_1 T_1}$; $V = \pi r^2 h$; $S.I = \frac{P.R.T.}{100}$

12.11.3-change the subject of a formula.	Formulae as used in 12.11.2.
12,11.4-expand and simplify algebraic expressions.	Expansions and simplifications of the type:- Expand: $2(x+3) + 3(x+1)$ $(b-8)(b+3)$ $\frac{3}{2} ax\ (4a^2x - 6ax^2)$ $2xy - xy + x^2y$
12.11.5-Solve simultaneous linear equations in two unknowns.	(a) Graphically. (b) By elimination. (c) By substitution.
	Solution of simultaneous linear inequations (by graphical method).

UNIT 12.13

INTRODUCTION

This unit concentrates the student's attention on the interpretation of graphically presented data.

It aims to make the student more discerning and to provide practice in reading information from a wide range of graphical presentations e.g. tables, line graphs, bar graphs, diagrams, maps, etc.

OBJECTIVES	CONTENT
When students have completed this unit they should be able to:-	
12.13.1-Read tables and scales.	Reading and interpretation of data presented in table form. Rainfall tables Population Crop growth Air travel
12.13.2-Select appropriate graph types. Construct the graphs from tables of data.	Picture graphs. Bar graphs. Multiple-bar graphs. Pie graphs. Line graphs. Trend graphs. Scatter diagrams.
12.13.3-interpret graphs.	Graphs of the type in 12.13.2. Interpolation. Extrapolation.
12.13.4-Recognise misleading graphs.	Graphs with - distorted scales - scales not beginning at zero - misleading presentations.
12.13.5-formulate a mathematical expression from a graph.	Mathematical interpretation of straight line graphs, parabolas, gradients and intercepts, equations.
12.13.6-interpret scale drawings.	Revision of measurement units. Maps. Plans. Drawings (motor cars, machine parts, etc.)
12.13.7-Make simple scale drawings.	Scale drawings of buildings, boats, etc. Drawing simple maps.

UNIT 12 .14

INTRODUCTION

The collection and analysis of data is basic to our understanding modern living both rural and urban.

This unit is aimed to deepen the student's knowledge and understanding of the basic principles used in the preparation and interpretation of statistics.

OBJECTIVES	CONTENT
When students have completed this unit they should be able to: 12.14.1-Calculate the mean of a set of numerical data.	Calculation of the mean from (a) frequency tables, (b) using an assumed mean. Revision of measures of central tendency.
12.14.2- Calculate the standard deviation of a set of numerical data.	Standard deviation (σ) $\sigma = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$
12.14.3-Interpret statistical data which has been grouped.	(a) Class intervals, mid-interval values. (b) Mode, median, mean. (c) Graphical representation.
12.14.4-Appreciate the idea of taking a sample of a set of data.	Different methods of sampling. (a) Small samples. (b) Large samples. (c) Random samples. (d) Stratified samples.
12.14.5-Correlate sets of data.	(a) Scatter diagrams. (b) Regression lines.

UNIT 12.15

INTRODUCTION

This unit aims to provide students with an awareness of the practical applications of trigonometry, surveying and cartography.

Though students are not likely to be involved professionally in such work they are very likely to make use of maps, charts and diagrams prepared for them.

This unit should give students an idea of how their previous study of trigonometry can be put to practical use.

OBJECTIVES	CONTENT
When students have completed this unit they should be able to:-	
12.15.1-understand basically how trigonometry is used in navigation.	Navigational situations. Bearings. Charts. Tracking. Spherical geometry.
12.15.2 - understand basically how trigonometry is used in surveying.	Surveys. Map making. Road construction. Building construction.
12.15.3-prepare a simple plan or map.	Drawing up a plan of the school grounds. Map of the locality. Plan of a building.

UNIT 12.16

THIS UNIT IS THE SAME AS UNIT 12.3 . AS A MINOR COURSE UNIT, EMPHASIS WILL NEED TO BE PLACED ON THE PRACTICAL ASPECTS OF ITS CONTENT.

UNIT 12.3

INTRODUCTION

It is felt that students at all levels need to appreciate the practical usage of Mathematics. This unit aims to encourage them to look , in some detail, at various common situations involving Mathematics.

Where possible examples used should be taken from real experiences likely to have been encountered by the students. Cross references to newspaper reports, government papers, banking procedures, etc, should be made to enhance the reality of the situations. Various projects could be developed to cover the material of the unit.

OBJECTIVES	CONTENT
When students have completed this unit they should be able to:-	
12.3.1- solve simple problems involving percentage calculations.	Profit/Loss Cost Price/Selling Price Discount Simple Interest Compound Interest

12.3.2- conduct a survey of a commercial project.	Commercial mathematics attendant to the organisation of any small business e.g. cash crop project; trade store; p.m.v. service; a building project; raising animals.
12.3.3- appreciate the comparative retail prices of commodities.	Study of prices of basic commodities from various suppliers e.g. local store; supermarket; bulk store; mail order.
12.3.4- understand the costs associated with the construction of a building.	Labour costs Material Facilities (water, electricity, telephone) Land costs
12.3.5- understand personal expenditure problems of modern living.	Payroll calculations Salaries Wages Overtime Income Tax Motor Car expenses Electricity, Water, Rates Bank loans

APPENDIX 4

(a) 1980 Major Mathematics Paper A

(b) 1980 Major Mathematics Paper B

69

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION - 1980

MATHEMATICS (MAJOR)

Paper A

Examination Time: 2 hours (plus 15 minutes reading time)

Name: _____

Number: _____

School: _____

INSTRUCTIONS TO CANDIDATES

1. This paper consists of 3 parts:

   PART A consists of 15 questions worth 1 mark each
   PART B consists of 10 questions worth 2 marks each
   PART C consists of 5 questions worth 3 marks each

   Answer ALL questions.

2. You will be supplied with graph paper and 4-figure tables. Calculators may be used.

3. Write your answers to each question in the space provided, and show your working where necessary.

DO NOT TURN OVER THE PAGE UNTIL YOU ARE TOLD TO START

PART A

There are 15 questions, each worth 1 mark.
Answer all questions in the space provided.

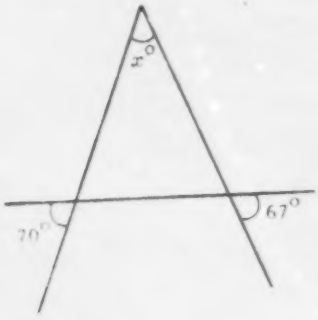
QUESTION 1

Solve for x

$$x - 2 = 4 - x$$

QUESTION 2

What is the value of x in the diagram below?



QUESTION 3

The mean of the four numbers 87, x, 94, 98 is 89.
Find the value of x.

QUESTION 4

What is the equation of the straight line which passes through the points (2,3) and (2,5) ?

QUESTION 5

A boat travels a distance of 88 kilometres in 5½ hours. What is its average speed for the trip?

QUESTION 6

Factorize

$$x^2y - 2xy^2 - 3x$$

QUESTION 7

Find the gradient of the linear graph with equation

$5y - 5x = 2$

QUESTION 8

Find the fourth term of an arithmetic sequence whose first term is 8 and second term is 4.

QUESTION 9

What is the magnitude of the vector $a\underline{i} + b\underline{j}$?

QUESTION 10

A jet plane travels 2 kilometres in 10 seconds. How far will it travel in an hour at this rate?

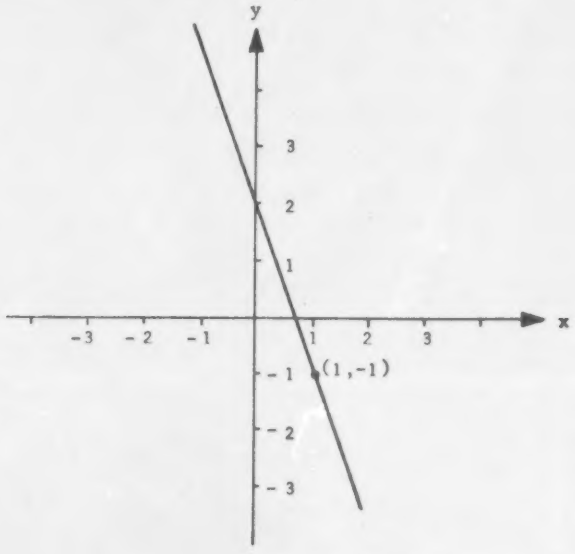
QUESTION 11

Simplify

$$\frac{8}{ab} - \frac{5}{ba}$$

QUESTION 12

What is the equation of the graph shown below?



QUESTION 13

What is the distance between the two points A(-1,2) and B(2,-2) ?
Express your answer in its simplest form.

QUESTION 14

What is the value of 2 cos x if $x = 60^{o}$?

QUESTION 15

What percentage of 250 is 15 ?

PART B

There are 10 questions, each worth 2 marks.
Answer all questions in the spaces provided
Show working, where necessary.

QUESTION 16

T_1, T_2, T_3, T_4 ....., is a geometric sequence. If $T_3 = 3$ and $T_4 = 1$, find T_1.

QUESTION 17

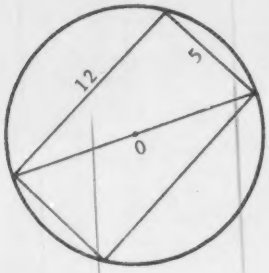
Find the mode and the median of the following numbers:
3, 7, 2, 6, 3, 5, 4, 3, 9, 4, 1.

QUESTION 18

Given the two points A(-3, -2) and B(0,2), find the coordinates of the point where the line joining A to B cuts the x - axis.

QUESTION 19

A rectangle 5cm x 12cm is inscribed in a circle as shown below. Find the circumference of the circle.



QUESTION 20

Solve for x

$$x^2 = 3x$$

QUESTION 21

If $\tan x = \frac{3}{4}$ and x is the 3rd quadrant, find

(i) $\sin x$

(ii) $\cos x$

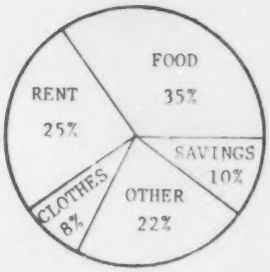
QUESTION 22

If $\frac{1}{x} = \frac{1}{a} + \frac{1}{b}$, find x in terms of a and b. Give your answer in simplest form.

QUESTION 23

The pie chart below represents how a family uses its income of K200 per fortnight. How many kina are

(i) saved?
(ii) spent on food and rent altogether?

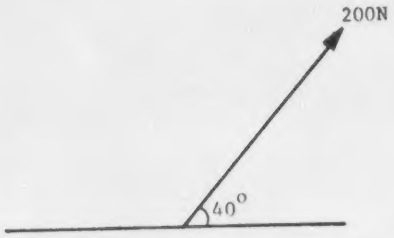


QUESTION 24

A force of 200 Newton acts on a body as shown in the sketch below.
Calculate

1) the vertical component of the force.
2) the horizontal component of the force.

Express each answer correct to the nearest whole number.



QUESTION 25

Find the mean of the following frequency distribution.

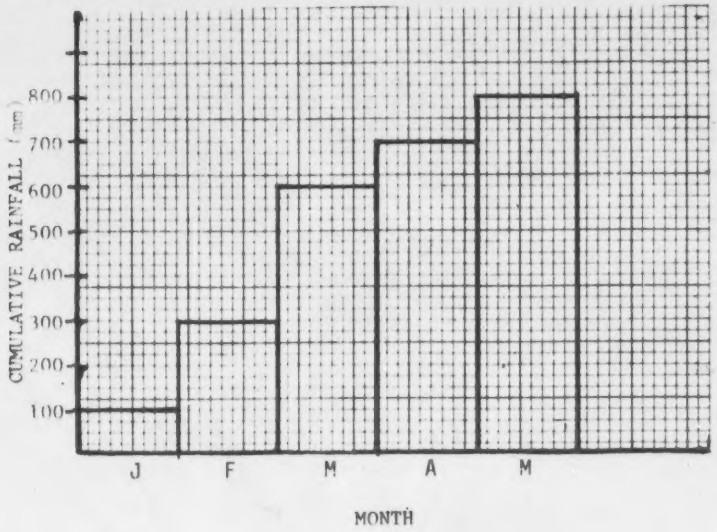
x	1	2	3	4
f(x)	3	6	8	3

PART C

There are 5 questions, each worth 3 marks.
Answer all questions. Show working, where necessary.

QUESTION 26

The graph below shows the cumulative rainfall in millimetres for the period January to May of a certain year.

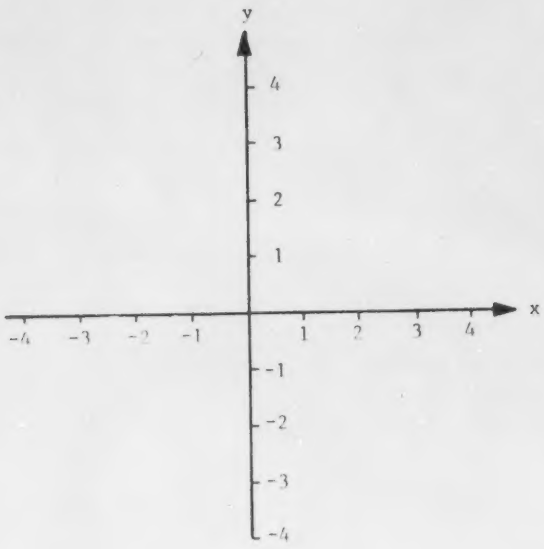


a) For which month was the rainfall greatest?

b) What was the mean monthly rainfall over the period January - May ?

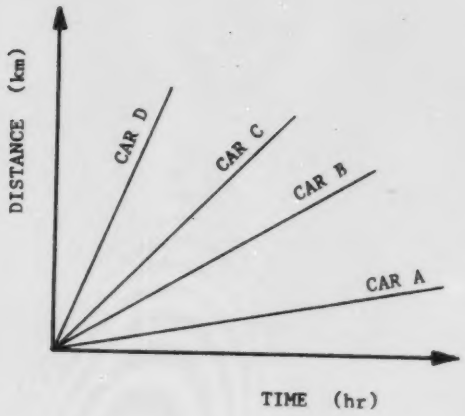
QUESTION 27

On the set of axes provided below, sketch the graph of $\{(x, y) : x^2 + y^2 = 41\}$
Clearly show on your graph the x and y intercepts.



QUESTION 28

Four cars, A, B, C and D leave the same place at the same time.
Their distance/time graphs are shown below.



a) Which car travels fastest ?

b) If they have the same destination, which car will take the longest time to reach this destination? (Assume their velocities remain constant.)

c) If the destination is 100 km from the start and Car C travels at 50 km/hr, how long will it take to reach the destination?

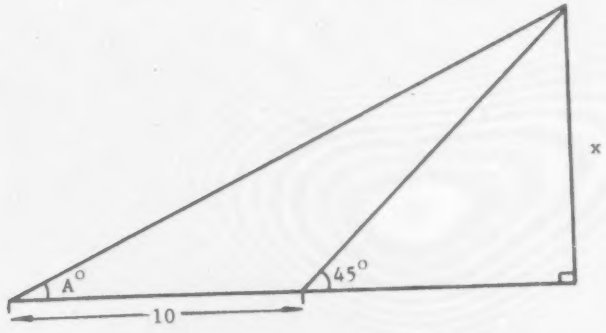
QUESTION 29

Use the Remainder Theorem to find all solutions of the equation:

$x^3 - 2x^2 - x + 2 = 0$. Show your working.

QUESTION 30

In the diagram below, find an expression for tan A in terms of x.



END OF EXAMINATION

Papua New Guinea

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION – 1980

MATHEMATICS (MAJOR)

PAPER B

Examination Time: 2 hours (plus 15 minutes reading time)

Name: _____

Number: _____

School: _____

Question Number	1	2	3	4	5	6	7	8
✓ if attempted								
Mark awarded **(Marker's use only)**								

INSTRUCTIONS TO CANDIDATES:

1. There are 8 questions in this paper worth 8 marks each. Answer any 6 questions. Indicate with ticks in the table above which 6 questions you have attempted.

2. You will be supplied with graph paper and 4-figure tables. Calculators may be used.

3. It is important that your working and answers to each question are given in full and written neatly in the space provided in the paper.

DO NOT TURN OVER THE PAGE UNTIL YOU ARE TOLD TO START

84

QUESTION 1

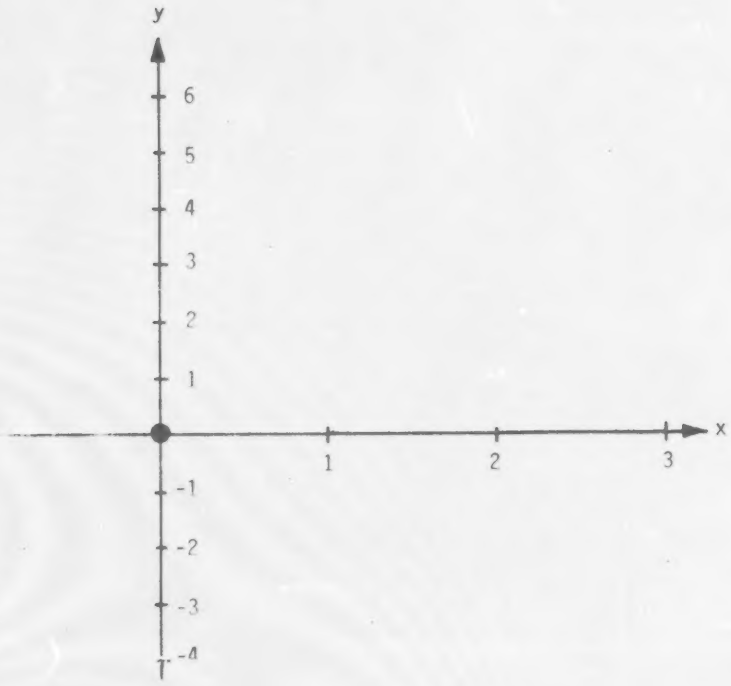
On the axes provided, plot, for $0 \leqslant x \leqslant 3$, the graphs of the functions:

a) $f(x) = x^2 - x$ (3)

b) $g(x) = 2x - 2$ (2)

c) State the coordinates of the points of intersection of the two graphs; (1)

d) hence find all the values of x for which $2x - 2 \geqslant x^2 - x$ (2)


y
6
5
4
3
2
1
x
1
2
3
-1
-2
-3
-4

QUESTION 2

a) Use the Remainder Theorem to show that $x = -1$ is a solution of $x^3 + 1 = 0$. (1)

b) Given that $x + 1$ is a factor of $x^3 + 1$, use algebraic division to find the other factor. (3)

c) Show, using the discriminant, that $x^2 - x + 1 = 0$ has no real solutions and hence explain why $x^3 + 1 = 0$ has only one real solution. (4)

QUESTION 3

Ten students sat for an English test and got the following marks (out of 10):

10, 9, 9, 9, 8, 7, 6, 6, 5, 1

a) Find the mean of the ten marks. (1)

b) Find the standard deviation of the mark. (3)

c) Did any students score a mark more than two standard deviations **above** the mean score? Explain your answer. (2)

d) Did any student score a mark more than two standard deviations **below** the mean score? Explain your answer. (2)

QUESTION 4

a) If a, b are the roots of the equation $3x^2 - 6x + 2 = 0$, calculate the value of $a^2 + b^2$. (3)

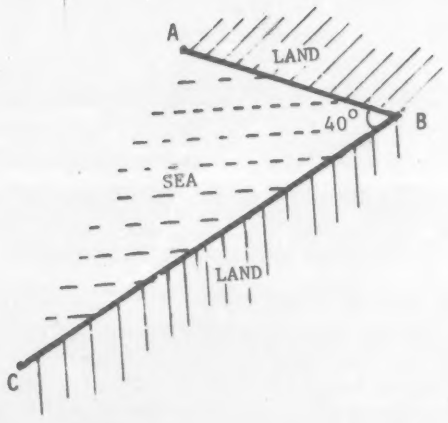
b) At the beginning of 1970 the population of island A was 1000 and the population of island B was 2000. During the next 10 years the population of island A **grew** at an average rate of 10% per annum so that its annual population during the 1970's could be regarded as a geometric sequence with first term 1000 and common ratio 1.1 The population of island B **fell** at an annual rate of 10% during the 1970's so that its annual population could be regarded as a geometric sequence with first term 2000 and common ratio 0.9 Which island, A or B, had the greater population at the beginning of 1980? Show all your working. (5)

QUESTION 5

a) A triangle ABC is such that AB = 2 km, BC = 4 km, and the angle at B is 40°. Use the cosine rule to find the length of AC.

(3)

b) A person at point A (see the diagram below) wishes to get to point C as quickly as possible. He can either run along land from A to B and then from B to C or he can paddle, in a canoe, directly from A to C. If AB = 2 km, BC = 4 km, the angle at B is 40°, and the person runs at an average speed of 6 km/hr and paddles at an average speed of 3 km/hr, would it take him less time to run from A to B to C or to paddle from A to C? Fully justify your answer. (You may use any calculations done in part (a) to help you answer part (b) (5)



QUESTION 6

Three points A, B, C have co-ordinates (–4, –2), (–1, 2), and (3, –1) respectively.

a) Prove that length AB = length BC. (2)

b) Find the co-ordinates of the mid-point of AC. (2)

c) Find the equation of the line which passes through B and is perpendicular to AC. (4)

QUESTION 7

a) Find the angle between the **directions** of the vectors $\underline{i}+\underline{j}$ and $\underline{i}+\sqrt{3}\underline{j}$ (4)

(b) During its first month of operation a small business has a total expenditure of K2000 and a total income of K1500. The monthly loss was therefore K500.

During its second month of operation the expenditure for the business increased by 40% and the income increased by 70%. What was the **profit or loss** for the second month?

QUESTION 8

A stone is thrown vertically into the air with an initial speed of 49 metre/second. Its height above the ground, h metres, after t seconds is given by the formula

$$h = 49t - 4.9t^2$$

Find, without using a graph,

a) its height above the ground after 3 seconds. (1)

b) its height above the ground after 3.5 seconds. (1)

QUESTION 8 (continued)

c) its average speed during the period 3 to 3.5 seconds. (2)

d) the total time taken until the stone hits the ground again. (2)

e) the maximum height above the ground reached by the stone. (2)

END OF THE EXAMINATION

94

APPENDIX 5

(a) 1980 Minor Mathematics Paper A

(b) 1980 Minor Mathematics Paper B

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION - 1980

MATHEMATICS (MINOR)

PAPER A

Examination Time: 2 hours (plus 15 minutes reading time)

Name: _____

Number: _____

School: _____

INSTRUCTIONS TO CANDIDATES

1. There are 50 questions in this paper worth 1 mark each. Answer ALL questions.
2. You will be supplied with graph paper and 4-figure tables. Calculators may be used.
3. Write your answers to each question in the space provided, and show your working where necessary.

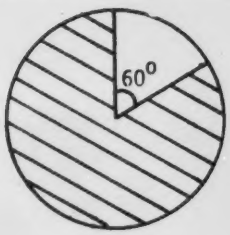
DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START

Question 1

The rates for a health insurance family scheme are 50t per week for an adult and 20t per week for a child. How much would a family with two adults and five children pay each week?

Question 2

A group of 720 students are represented by the total pie chart. How many students are represented by the unshaded part?



Question 3

A man invested K1000 at 7½% simple interest for 10 years. How much interest would he get altogether?

Question 4

A province has 25 fatal accidents in a certain year. The following year, the number of fatal accidents increased by 20%. How many accidents occurred in that year?

Question 5

If one truck can carry a load of $5m^3$ of stones, how many trucks will be needed to carry $320m^3$ of stones at the same time?

Question 6

A man earns x kina per week. He spends y kina per week and saves the rest. Find an expression involving x and y for how much he saves in 3 weeks.

Question 7

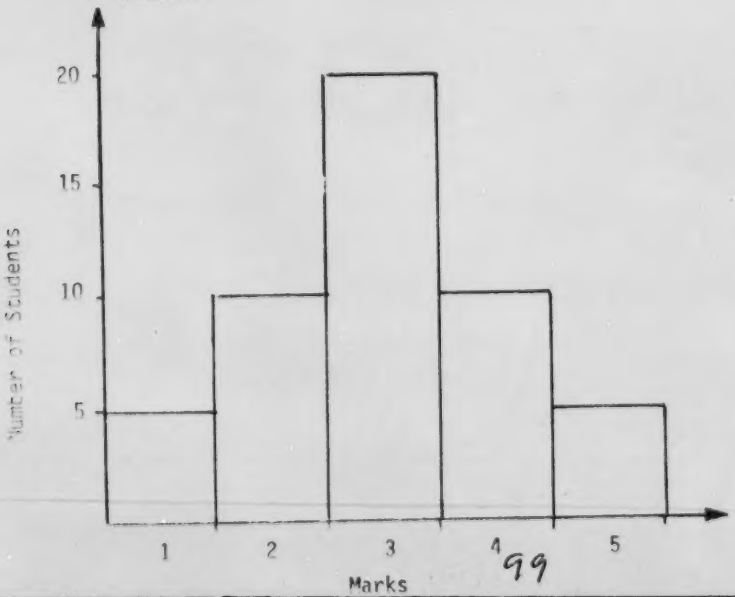
Find the mean of the numbers: 35, 42, 46, 13, 34

Question 8

Expand and simplify: $3(x + 2y) - 2(x - y)$

Question 9

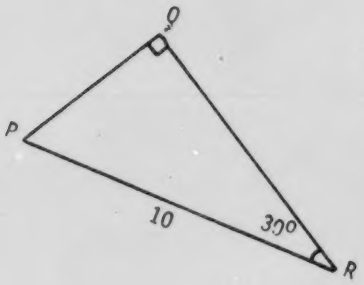
The histogram below shows the scores of a number of students on a test (out of 5 marks). What percentage of the students scored 3 marks?



99

Question 10

Given the diagram below, find the length of PQ.



Question 11

Solve for x:

$$2x + \frac{x}{2} = 20$$

Question 12

The perimeter of a square is 40cm. What is the area of the square?

Question 13

If $\frac{1}{x} = \frac{1}{4} + \frac{1}{3}$, find the value of x.

Question 14

Evaluate $(3x - 2y)$ when $x = 2$, and $y = -1$.

Question 15

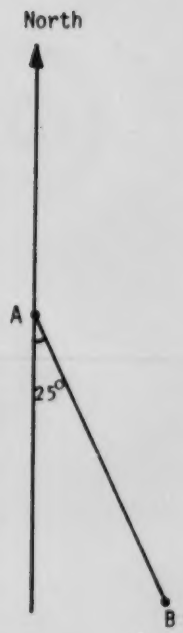
Convert $40\,000 cm^2$ to square metres.

Question 16

Two cubes have sides of 2cm and 4cm. Find the ratio of the volume of the smaller cube to the larger one.

Question 17

What is the bearing of B from A?



Question 18

K300 is divided into three parts in the ratio 6 : 5 : 4. What is the value of the largest part?

Question 19

Calculate the mean of $\frac{a}{2}$, a , $\frac{3a}{2}$, 2a.

Question 20 and 21 refer to this information:

The scores on a test were:

3, 5, 5, 7, 8, 9, 9, 10, 12, 13, 13, 14, 15, 16, 16, 19.

Question 20

What is the median of the scores?

Question 21

What percentage of the scores are less than 15?

Question 22

Evaluate $\sin 67^{o}32'$

Question 23

A fair die numbered 1 to 6 is thrown. What is the probability that the number that comes up is less than 5?

Question 24

Which of the following statements is true?

a) $\sqrt{a^2 + b^2} = a + b$

b) $(a + b)^2 = a^2 + b^2$

c) $(a - b)^2 = a^2 + b^2$

d) $a^2 + (-b)^2 = a^2 + b^2$

Question 25

Simplify the expression:

$$\frac{x^2 + 2ax}{2x}$$

Question 26

Make x the subject of this formula:

$$\frac{3x - b}{5} = c$$

Question 27

What is the gradient of the line AB shown in the diagram?

Question 28

Expand and simplify: $(3x - 4)(2x + 1)$

Question 29

What are the coordinates of the x-intercept of the line whose equation is $3x - 4y = 2$?

Question 30

A man earns K2.00 an hour when he works between 8 a.m. and 4 p.m. After 4 p.m. the overtime rate is K3.00 an hour. How much will he earn if he works without stopping from 8 a.m. to 7 p.m.?

Question 31

The table below shows the number of drivers in a town holding a particular class of licence. What percentage of drivers hold a Class 6 licence?

Class No.	1	2	3	4	5	6
No. of drivers	30	6	4	3	7	10

Question 32

70 tickets are sold in a lottery. 40 men and 30 women buy the tickets. What is the probability that a woman will win?

Question 33

Solve the following simultaneous equations for x:

$3x - y = 1$

$2x - y = 4$

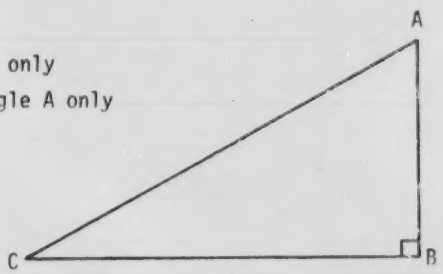
Question 34

Two towns are 60 km apart. How far apart will the towns appear on a map with a scale of 1:100 000? Express your answer in centimetres.

Question 35

In the right-angled triangle shown below, I want to calculate the side AB. What information do I need? Choose one of the following:

a) angle C only
b) side BC only
c) angles C and A only
d) side AC and angle A only



Question 36

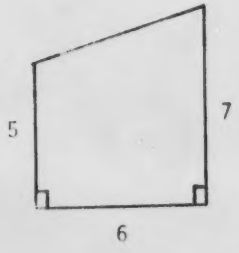
Evaluate $(25 - 16)^{\frac{1}{2}}$

Question 37

The sum S of the interior angles of an n-sided polygon is $S = (n - 2) \times 180^{\circ}$. How many sides has the polygon whose interior angles add up to 720°?

Question 38

What is the area of the figure shown below?



Question 39

Which is the largest of the following fractions?

$\frac{7}{8}$, $\frac{3}{4}$, $\frac{9}{11}$, $\frac{4}{5}$.

Question 40

A grower wants to sell his coffee beans. Four dealers buy coffee beans at the rates given below. Which rate is the best for the grower?

a) K80 per 100 kg
b) K60 per 70 kg
c) K100 per 150 kg
d) K90 per 120 kg

Question 41

Express 0.0000419 in scientific notation.

Question 42 and 43 refer to this information:
The table below shows the number of employees in a company receiving a particular weekly wage.

Weekly Wage (K)	40	50	60
No. of Employees	3	5	4

Question 42

How much does the company pay out in wages each week?

Question 43

What fraction of the employees receive less than K60 per week?

Question 44

The formula $r = \frac{6}{s + 2}$ relates two variables r and s. If the value of s increases, then the value of r

a) increases.
b) remains constant.
c) decreases.
d) increases then decreases.

///

Question 45

The instructions on a bottle of tablets say that a person should take two tablets per 100 kg of body weight. If a man weighs 65 kg, how many tablets should he take?

Question 46

We have two numbers m and n. If the sum of 7 and m is double the value of n, this may be expressed as:

a) $m + 7 = n + 2$

b) $m = 2n + 7$

c) $2m + 7 = n$

d) $m + 7 = 2n$

Question 47

Find one of the equations below which fits the following table of values.

x	-2	-1	0	1	2
y	-4	-1	2	5	8

a) $2y = 3x + 2$

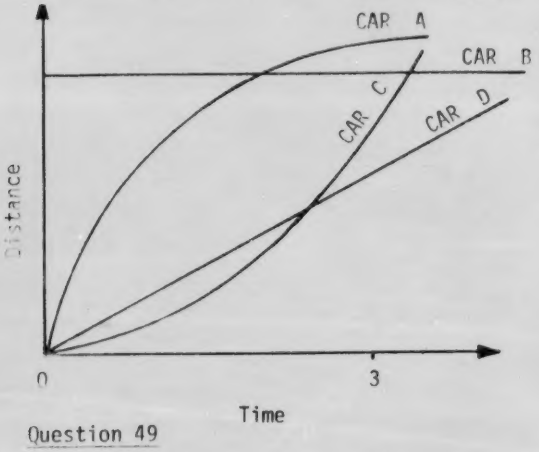
b) $y = 3x + 2$

c) $y = x^2 + 2$

d) $y = -3x + 2$

Question 48

The distance-time graphs of four cars are shown below. When $t = 3$, which car has the greatest speed?



Question 49

Find the mode of the following numbers:

1, 3, 7, 2, 5, 5, 4, 2, 6, 9, 2, 8.

Question 50

If x is an acute angle and $\sin x = 0.7071$, find x.

113

END OF EXAMINATION

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION - 1980

MATHEMATICS (MINOR)

PAPER B

Examination Time: 2 hours (plus 15 minutes reading time)

Name: _____

Number: _____

School: _____

Question Number	1	2	3	4	5	6	7
√if attempted							
Mark awarded (Marker's use only)							

INSTRUCTIONS TO CANDIDATES

1. There are 7 questions in this paper worth 10 marks each. Answer any 5 questions. Indicate with ticks in the table above which 5 questions you have attempted.

2. You will be supplied with graph paper and 4-figure tables. The use of a calculator, ruler, compasses and protractor is permitted.

3. It is important that your working and answers to each question are given in full and written neatly in the space provided in the paper.

DO NOT TURN OVER THE PAGE UNTIL YOU ARE TOLD TO START

Question 1

(a) $2n - 1$, $2n + 1$, and $2n + 3$ are three consecutive odd numbers. The sum of the three numbers is 171.

(i) Find the value of n.

(ii) Find the three odd numbers.

(3)

(b) Solve for x :

$$\frac{x - 6}{2} + \frac{x + 2}{5} = 3$$

(3)

(c) A ship sails 300 km from a port at a bearing of 40°. It then changes direction and sails 400 km at a bearing of 130°.

(i) Show the path of the ship on an accurate scale drawing.

(ii) From the drawing, or otherwise, work out how far the ship is from the port?

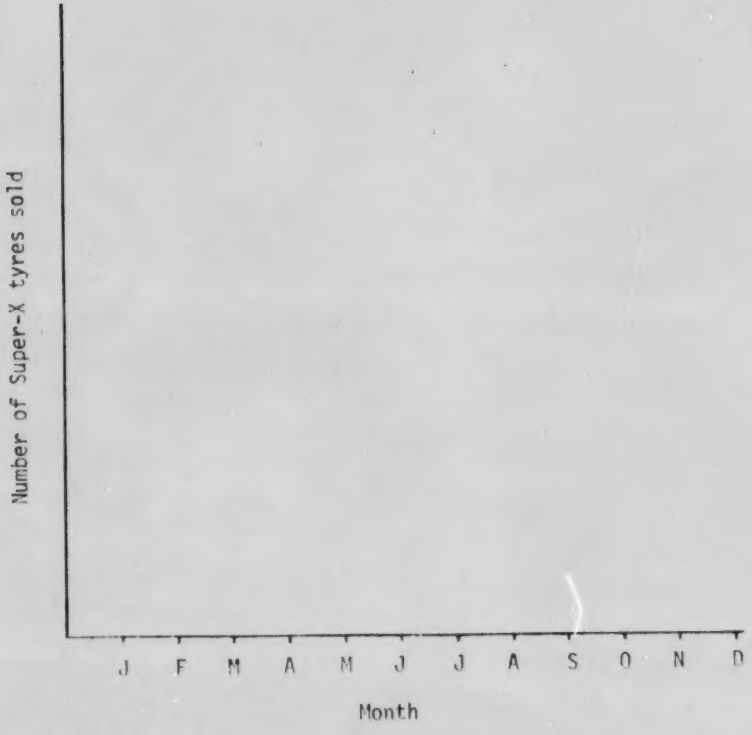
(4)

Question 2

Suppose the number of Super-X car tyres sold each month by a service station during 1979 is as shown in the following table.

Month	Number of Super-X tyres sold	Month	Number of Super-X tyres sold
January	10	July	5
February	8	August	8
March	6	September	6
April	6	October	7
May	5	November	9
June	7	December	7

(a) Represent the information in the above table as a bar graph.



(3)

Question 2 (continued)

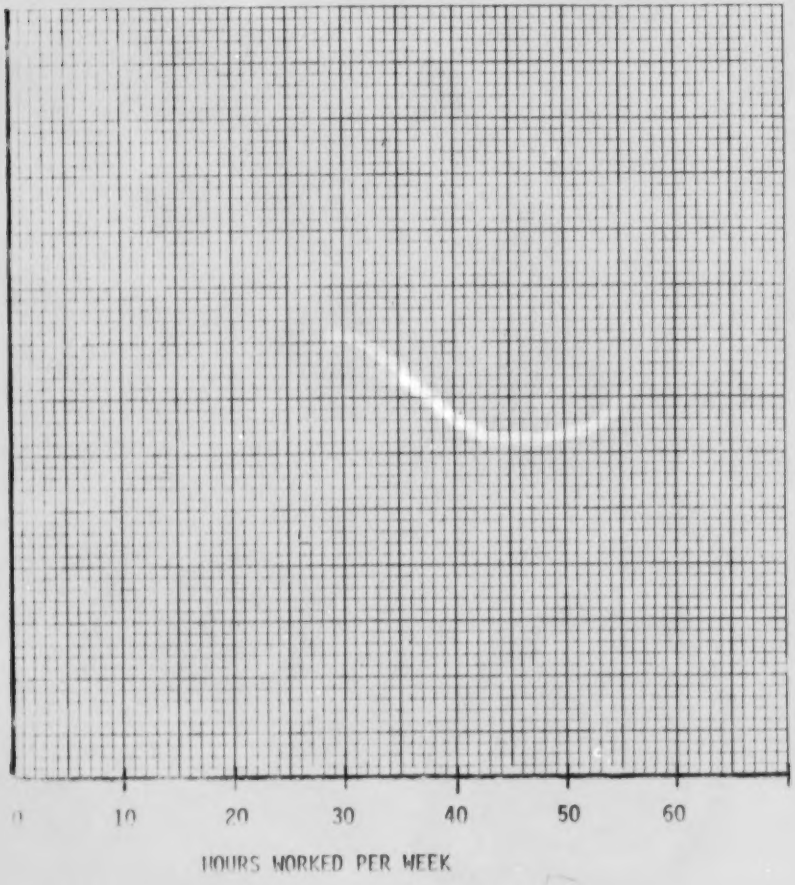
(b) Calculate the mean and standard deviation for the monthly sales of Super –X tyres. Show all your working, and give the standard deviation correct to 2 decimal places.

(7)

Question 3

A craftsman earns K3.00 per hour for the first 40 hours he works during a week and K4.50 per hour for work done in addition to the first 40 hours.

(a) Using the axes provided, draw a graph from which his weekly earnings, up to 60 hours, could be calculated.



(4)

Question 3 (continued)

(b) Using your graph, or otherwise, find, showing all your working,

(i) his earnings if he worked 36 hours in one week.

(2)

(ii) his earnings if he worked 54 hours in one week.

(1)

(iii) the number of hours he worked in a week if he earned K174.

(3)

Question 4

Four trees, A, B, C and M, grow on a flat piece of land. A is 400 metres from B, C is 500 metres from B, C is 200 metres from A, and M is exactly halfway between A and C.

(a) Draw a map, with a scale of 2 centimetre for 100 metres, showing A, B, C, and M. (Make A, B, C, the vertices of a triangle).
(Hint: use a pair of compasses to mark A, B and C.)

(4)

Question 4 (continued)

(b) By measuring with a ruler, use your map (from part (a)) to find the distance, in metres, from tree B to tree M Give your answer to the nearest 10 metres. Explain your answer

(3)

(c) Calculate the time, in minutes and seconds, it would take someone to walk from B to C given that the person walks at an average speed of 2 metres per second. Show your working.

(3)

Question 5

A radio costs a store owner K60. He adds 40% to the cost price for his profit, and obtains his marked price. He then sells the radio to a friend, giving him a 15% discount on the marked price.

(a) What price did the friend pay for the radio?

(3)

(b) What percentage profit (based on the cost price) did the store owner make when he sold the radio to his friend?

(4)

(c) If, one month later, the friend sold the radio at 10% profit, for what price did he sell the radio?

(3)

Question 6

(a) The volume, V of a sphere of radius r is given by the formula:

$$V = \frac{4}{3}\pi r^3$$

Taking π as equal to $\frac{22}{7}$, find the volume of a sphere whose radius is 7 cm.

(3)

(b) A service station proprietor sells petrol for 32 toea per litre and kerosene for 40 toea per litre. On a certain day he sells 800 litres of petrol and kerosene altogether, and his takings are K280. How many litres of petrol did he sell on that day?

(7)

Question 7

Find, to the nearest toea, the interest on K1287.00 if this amount is invested at

(a) 9% per annum simple interest for three years.

(3)

(b) 9% per annum compound interest for three years.

(7)

125 END OF EXAMINATION

APPENDIX 6

(a) 1981 Major Mathematics Paper 1

(b) 1981 Major Mathematics Paper 1

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION – 1981

MATHEMATICS (MAJOR)

Paper 1

Examination Time: 2 hours

Name: _____

Number: _____

School: _____

INSTRUCTIONS TO CANDIDATES

1. This paper consists of 3 sections:
   SECTION A consists of 10 questions worth 1 mark each
   SECTION B consists of 7 questions worth 2 marks each
   SECTION C consists of 8 questions worth 3 marks each
   Total: 48 marks.
   Answer ALL questions.

2. You will be supplied with 4-figure tables.
   Calculators may be used.

3. Write your answer to each question in the space provided, and show your working where necessary.

DO NOT TURN OVER AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.

SECTION A

There are 10 questions, each worth 1 mark.
Answer all questions in the space provided.

QUESTION 1

Factorize $9p^2 - 4q^2$

QUESTION 2

Evaluate $(-3)^3$

QUESTION 3

In a pack of 52 playing cards, half the cards are black and the rest red. If asked to pick one card at random from the pack, what is the probability that you will take a red card?

QUESTION 4

A report on the sale of cattle read:

"..... and the cheapest sold at K35,
the highest at K90,
most sold at K70."

Which type of average has been referred to?

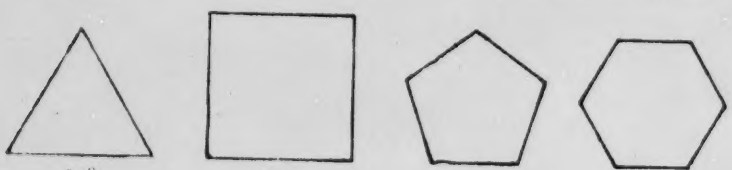
QUESTION 5

Find

$$\lim_{x \to 3} \frac{x^2 - 9}{x - 3}$$

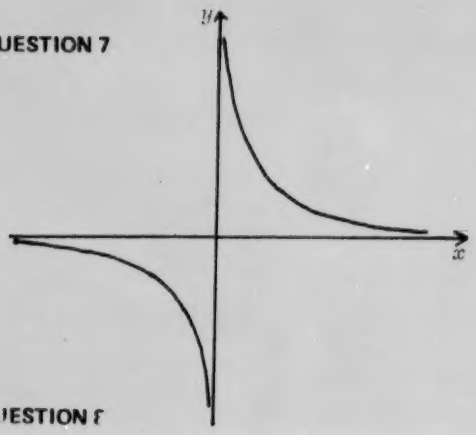
QUESTION 6

The sizes of the interior angles of these regular polygons form a sequence



Why is this sequence NOT an arithmetic progression?

QUESTION 7



What is the general equation of this curve?

QUESTION 8

Which of these points:

(5,5), (4,5), (5,4)

obeys the rule $2x + y \leq 13$?

QUESTION 9

Make r the subject of this formula.

$$W = p\pi r^2 h$$

QUESTION 10

An unbiased, eight sided die (an octahedron) has faces numbered

1, 2, 3, 4, 5, 6, 7, 8

What is the probability of obtaining a 4 on one throw?

SECTION B

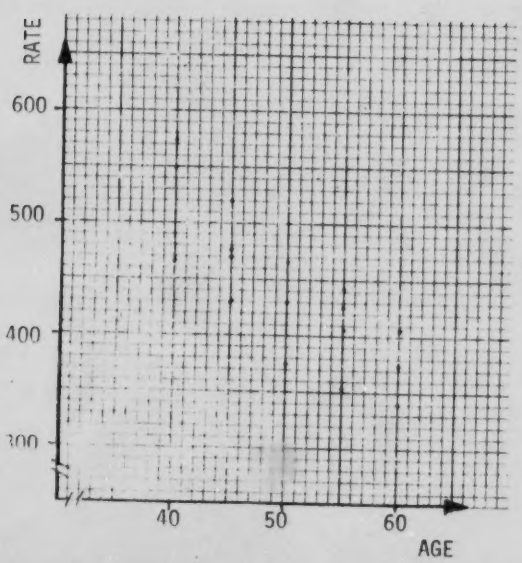
There are 7 questions, each worth 2 marks.
Answer all questions in the space provided.
Show working, where necessary.

QUESTION 11

Explain why there is no simultaneous solution to the two quations

$x + y - 5 = 0$ and $x + y + 5 = 0$

QUESTION 12



This scattergram shows the rate of flow of blood through the kidneys for a group of people compared with their ages in years.

(a) Draw, by eye, the regression line for this scattergram.

(b) What estimate of rate of blood flow can be made for a 48 year old person?

QUESTION 13

Differentiate $3q^2 - \frac{q}{2}$ with respect to q.

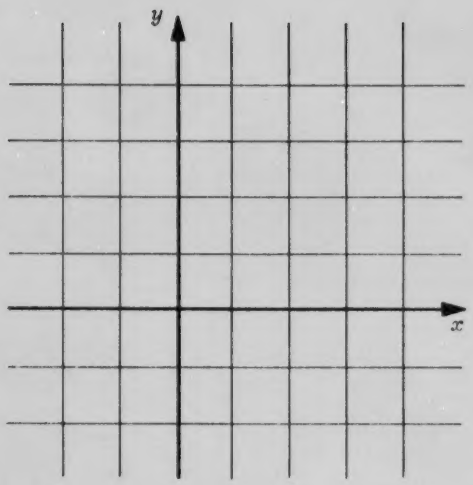
QUESTION 14

Evaluate $\sin 210^0 =$

$\cos 2.1 =$

QUESTION 15

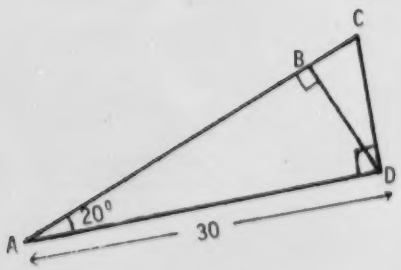
Plot the graph of $y = 2^x$ for $-2 \leq x \leq 2$



QUESTION 16

What is the gradient of a line perpendicular to $y + 2x - 4 = 0$?

QUESTION 17



Calculate the length of BD.

SECTION C

There are 8 questions, each worth 3 marks.
Answer all questions.
Show working where necessary.

QUESTION 18

Simplify $\frac{d^2 + d - 2}{d^2 - 1}$

QUESTION 19

There are three children in a family. What is the probability of the family having two boys and a girl born

(i) in any order?

(ii) in the order boy, girl, boy?

QUESTION 20

An egg farm kept a record of the number of eggs laid over five weeks in four different chicken pens.

Chicken Pens	Week 1	Week 2	Week 3	Week 4	Week 5
Pen 1	80	84	86	87	87
Pen 2	81	83	83	84	85
Pen 3	79	81	84	86	89
Pen 4	72	80	84	87	88

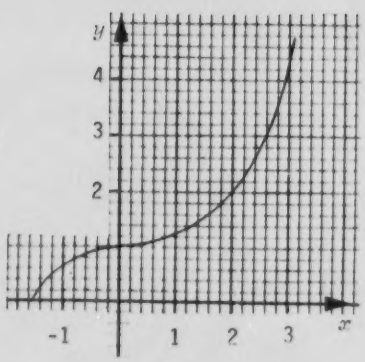
(i) Which pen had the greatest range? .....

(ii) Which pen had the greatest median? .....

(iii) If Pen 4's first entry had been 82, which would be affected, , the mean, the mode or the median? .....

QUESTION 21

What is the gradient at the point $x = 2$ of this curve?



QUESTION 22

If $t_n = a + (n - 1)\,d$

and $S_n = \frac{n}{2}\,[2a + (n - 1)\,d]$

Find d when $t_6 = 19$

and $t_1 + t_2 + \ldots\ldots\ldots + t_9 = 144$

QUESTION 23

$x + 2$ is a factor of $x^3 + x^2 - ax + 2$

Find the value of 'a'.

QUESTION 24

A metal rod is 2m long and has one end hinged to a fixed point. The other end swings through an angle of $\frac{\pi}{10}$ radians.
What area has been covered by the rod?

QUESTION 25

The following points, (1,6), (0,1), (3,28)
lie on the curve $y = ax^2 + bx + c$.
Find a, b, c.

END OF EXAMINATION

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION – 1981

MATHEMATICS (MAJOR)

Paper 2

Examination Time: 2 hours 15 minutes

Name: _____

Number: _____

School: _____

INSTRUCTIONS TO CANDIDATES

1. There are 8 questions in this paper, the marks for each are shown in brackets.
   Total: 52 marks.
   Answer ALL questions.

2. You will be supplied with 4-figure tables.
   Calculators may be used.

3. You will need to use mathematical drawing instruments for some questions.

4. Write your answer to each question in the space provided, and **ALWAYS** show your working.

DO NOT TURN OVER AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.

QUESTION 1

a) Solve $0 = 3h^2 + 7h + 2$

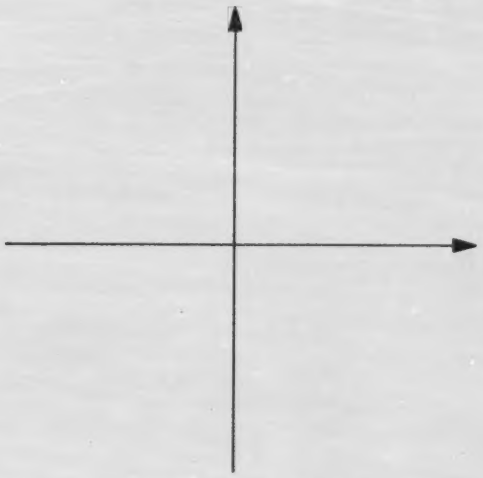
(2 marks)

b) Sketch $g = 3h^2 + 7h + 2$

Clearly label with their co-ordinates

(i) the vertex (or turning point)

(ii) the points where the curve crosses the 'h' and 'g' axes.



(4 marks)

c) Shade in the area on your sketch graph in (b) where the following inequalities are both true.

$g \leq h + 2$

$g \geq 3h^2 + 7h + 2$

(c) G: 33.90%
B: 35.66%
T: 35.26%

(2 marks)

QUESTION 2

a) Q is the point (0,0), A is the point (2,0) and C is the point (1,2).
Point B is chosen to make a parallelogram QABC.
What are the coordinates of B?

(1 mark)

b) What is the length of diagonal AC of the parallelogram QABC?

(2 marks)

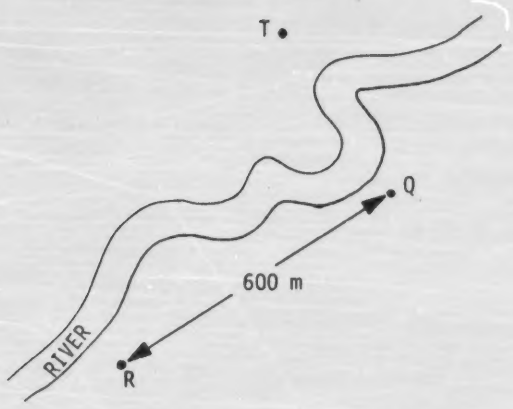
c) Show that the line QB passes through the midpoint of AC.

(5 marks)

QUESTION 3

Two trees, R and Q, on one bank of a river are 600 metres apart. Q is North-East of R. From R the bearing of a tower T, on the other side of the river is 031°, from Q the bearing of the same tower is 339°. Calculate the distance from Q to the tower.

This diagram is not a scale drawing. (6 marks)



QUESTION 4

An aircraft is flying at an air speed of 720 km/h on a bearing of 090°. The navigator finds that their ground speed is 800 km/h and on a bearing of 080°.
The weather forecast had predicted a wind of 15 km/h with bearing of 030°.

By scale drawing, determine by how much:

a) the strength of the wind had changed,

b) the direction of the wind had changed.

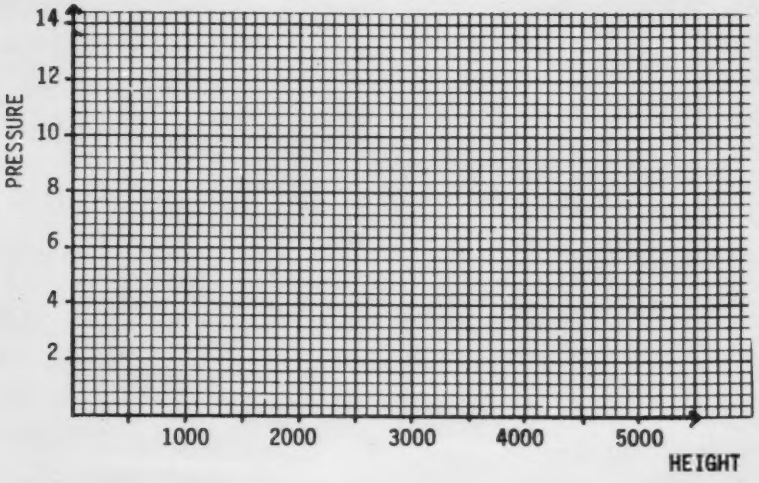
(6 marks)

QUESTION 5

A climber measured the air pressure as he went up a mountain.
He measured the height in metres above sea level.
He obtained the following data:

Height above sea level (m)	Air Pressure (units)
450	13.0
1768	12.6
2450	10.9
4005	9.0
4880	7.8

a) Use the grid to graph the results and draw the line of best fit.
(2 marks)



b) Which reading seems to be inaccurate? (1 mark)

c) What is the equation which best relates the air pressure to the height?
(2 marks)

QUESTION 6

On a certain mountain top a climber who loses control and begins to fall, will slide faster and faster down hill.

When conditions were at their worst on the mountain top, a climber slipped over and slid for a distance of 'y' metres in 't' seconds where

$$y = 0.15\ t^2 + 0.002\ t^3$$

a) Differentiate to find the expected speed of slide after 2 seconds.

(3 marks)

b) Fortunately the climber was carrying an axe. By pressing this axe hard into the earth the climber could slow down his slide up to the moment when his speed reached 3.6 metres/sec.

Calculate how many seconds the climber had in which to start using his axe in this way to stop his slide.

(4 marks)

QUESTION 7

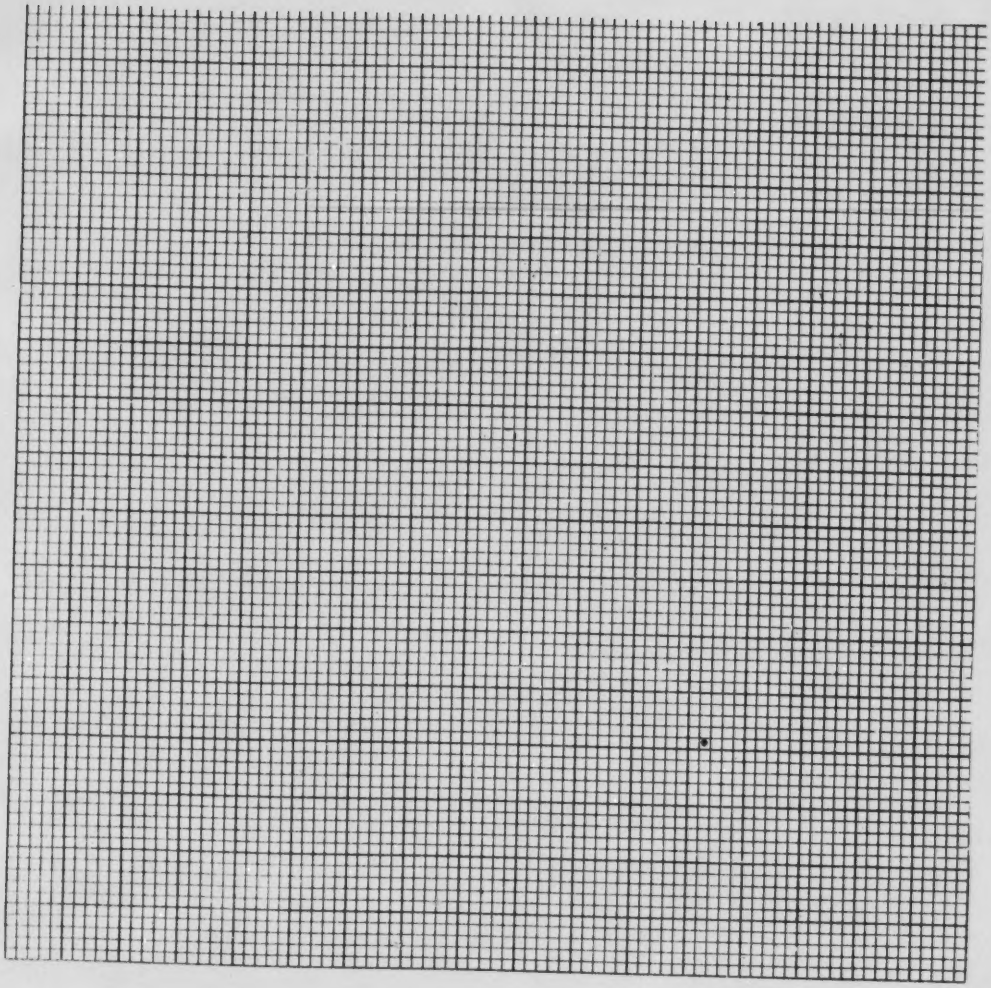
A survey was conducted in a city to find the average number of hours worked per week by a group of wage earners. The results of the survey are given below.

Average hours worked per week	Number of people
25 - 29	1
30 - 34	10
35 - 39	46
40 - 44	63
45 - 49	32
50 - 54	21
55 - 59	5
60 - 64	1

a) Use the grid on the next page to plot a cumulative frequency curve for this data. (4 marks)

b) What is the interquartile range for this data? (2 marks)

c) What is the median hours worked per week ? (1 mark)



QUESTION 8

A prisoner is trapped in an underground cell. A sudden rush of water pours in and forms a pool 1 metre deep.
After an hour another rush of water occurs, but this time the level rises by only $\frac{1}{3}$ metre.
After a second hour, another rush of water occurs and raises the level by $\frac{1}{9}$ metre. This process continues.

a) How high will the water have risen after five hours?

(3 marks)

b) The prisoner is 2 metres tall.
Show mathematically, that if he keeps standing he will not drown, no matter how long this process continues.

END OF EXAMINATION

APPENDIX 7

(a) 1981 Minor Mathematics Paper 1

(b) 1981 Minor Mathematics Paper 2

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION – 1981

MATHEMATICS (MINOR)

Paper 1

Examination Time: 2 hours

Name: _____

Number: _____

School: _____

INSTRUCTIONS TO CANDIDATES

1. There are 50 questions in this paper each worth one mark each.
   Total: 50 marks.
   Answer ALL questions.

2. You will be supplied with 4-figure tables.
   Calculators may be used.

3. Write your answer to each question in the space provided, and show your working where necessary.

4. You will need to use mathematical drawing instruments for some questions.

DO NOT TURN OVER AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.

QUESTION 1

5 percent of a pile of 40 boxes of paper were damaged by water.
How many boxes were damaged?

QUESTION 2

In a class there are 10 girls and 20 boys.
The girls have an average mathematics mark of 6.0
The boys have an average mathematics mark of 7.0
What is the average for the whole class correct to one decimal place?

QUESTION 3

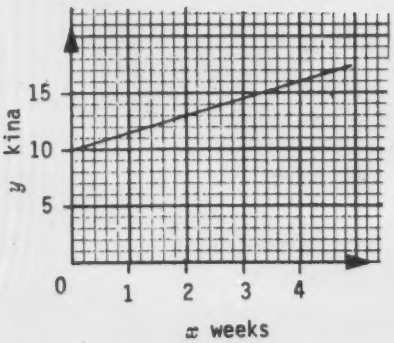
A line has the equation $2x + y = 6$
What is its gradient?

QUESTION 4

How many degrees does θ equal ?

QUESTIONS 5 and 6 refer to the following graph.

This graph represents Api's total savings, y kina, at a time x weeks after he started a new job.



QUESTION 5

What were Api's total savings before he started his new job?

QUESTION 6

How much does Api save each week?

QUESTION 7

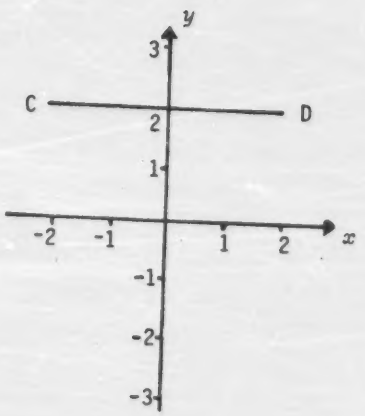
Evaluate cos 78° 12'

QUESTION 8

Factorize $2x^2 - x - 6$

QUESTION 9

What is the gradient
of the horizontal line CD?



QUESTIONS 10, 11 and 12 refer to the following information.

The profit made by a picture theatre owner is given by the formula:

$$P = 4t - 350$$

where 'P' kina is the profit, and 't' is the number of tickets sold.

QUESTION 10

If he sold 200 tickets, how much profit did he make?

QUESTION 11

What is the smallest number of tickets he must sell on any night in order to avoid making a loss?

QUESTION 12

If he made a loss on Monday night of K50, how many tickets did he sell?

QUESTION 13

A	B
1	3
2	5
3	7
4	9

What formula connects 'A' and 'B' for this table of values ?

QUESTION 14

The wire between two electricity poles on the side of a road is 120 m long. If the wire stretches by 3% of its length, what is its new length?

QUESTION 15

Make 'n' the subject of this formula:

$$S = 4 - \tfrac{1}{2}n$$

QUESTION 16

A salesman receives a salary of K50 per week, together with a commission of 7% on all his sales. Calculate his total earnings in a week in which he sold K800 worth of goods.

QUESTION 17

Beno was counting pigs, and Peter was counting dogs. Altogether they counted 56 of these animals. If Peter counted 'n' dogs, how many pigs did Beno count?

QUESTION 18

What is the y intercept of the graph with equation $x^2 + y = 6$?

QUESTIONS 19 to 22 refer to the following information.

A P.M.V. owner charges passengers 25t per ride. He has the following 'costs per week' to meet:

Petrol	K40.00
Maintenance	K15.00
Registration	K 3.00
Insurance	K 2.00
Other	K10.00

QUESTION 19

What percentage of the total cost is the cost of petrol?

QUESTION 20

How many passengers must he carry each week to pay all his costs?

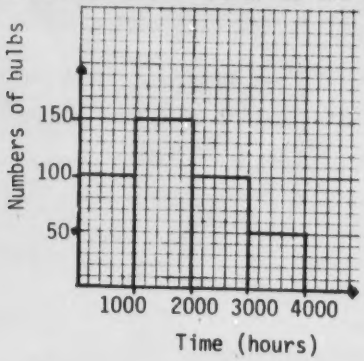
QUESTION 21

The owner had an accident which cost him K50 for repairs.
How many extra passengers must he need to carry in the next two weeks to cover this expense?

QUESTION 22

The price of petrol rose by 3.5%.
By how many kina will his total costs per week increase?

QUESTIONS 23 and 24 refer to the following graph.



This graph shows the results of testing the life of electric light bulbs.

QUESTION 23

How many bulbs in the sample have lives between 1000 and 2000 hours?

QUESTION 24

What was the number of bulbs which lasted for longer than 2000 hours?

QUESTION 25

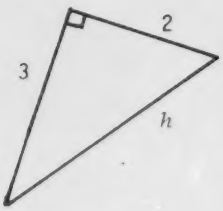
Which of the following best describes the size of shoe that a shoe shop should keep well stocked?

A. the mode size
B. the median size
C. the mean size
D. size 7

QUESTION 26

In its second year of production, a factory had an output 2½ times the output in its first year. Express this output as a percentage of the first years output.

QUESTION 27



Find length h

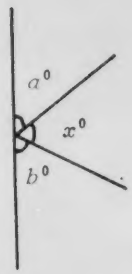
QUESTION 28

If a ball of string costs 15 toea, and X toea is the cost of Y balls of string, what formula connects Y and X ?

QUESTION 29

If $x = -2$ evaluate $2x^4$.

QUESTION 30



Write an expression for the value of x.

QUESTION 31

The distance between two points on a map of the University of Technology is 7.5 cm. The actual distance between the places is 750 m. What is the scale of the map?

QUESTION 32

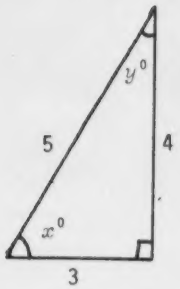
From the information shown in the diagram, which of the following is the largest?

A. $\sin x^\circ$

B. $\sin y^\circ$

C. $\tan y^\circ$

D. $\tan x^\circ$



Ans: _____

QUESTION 33

Which of the following steps leads directly to the value of x in the equation $x + 10 = 3$?

A. add 10 to each side

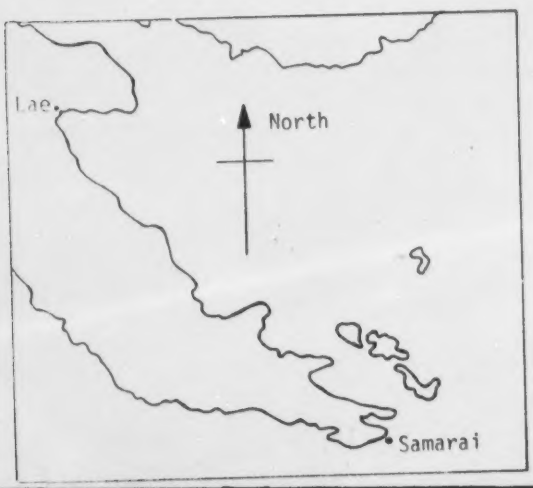
B. subtract 10 from each side

C. add 3 to each side

D. subtract 3 from each side

Ans: _____

QUESTION 34



What is the bearing of Lae from Samarai?

161

QUESTION 35

What type of curve has this equation?

$$2x^2 + 3 = y$$

QUESTION 36

A person earns K1.50 per hour working on week days, but earns K3.00 per hour for working on Saturdays.
His total earnings per week (T kina) is given by

$$T = 1.5\ w + 3.0\ s$$

'w' represents the number of hours worked on week days.
What does the symbol 's' represent?

QUESTION 37

Convert 100 cm^3 into m^3.

QUESTION 38

If $\cos x^{\circ} = 0.7157$,
what value does x have?
(x° is less than 90°)

QUESTION 39

Which of the following best explains the statement
"the probability that it will rain tomorrow is one"?

A. It will certainly rain tomorrow.

B. It will probably rain tomorrow.

C. It might rain tomorrow.

D. It will not rain tomorrow.

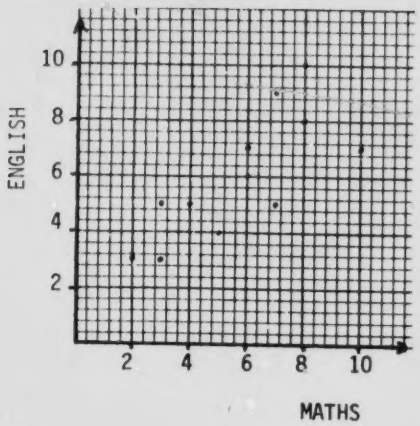
E. I do not know whether it will rain tomorrow.

Ans: _____

QUESTION 40

A tower is south west of you.
What is its bearing from your position?
Give your answer in degrees.

QUESTION 41



This graph shows the marks obtained by a group of students in English and Maths.

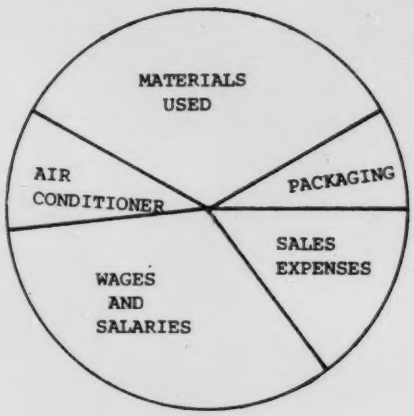
Is there a positive correlation, a negative correlation or no correlation at all between the marks?

Ans: _____

QUESTION 42

The pie chart shows the way in which a company's total manufacturing costs of ₦240 000 for a year were made up.

What was the cost of wages and salaries?

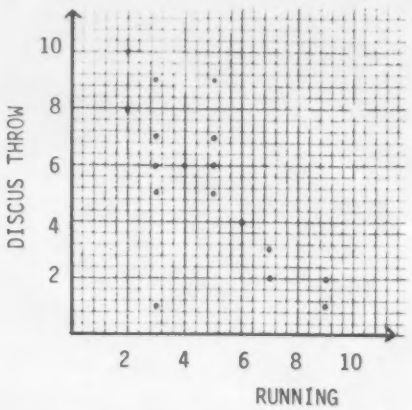


QUESTION 43

The time is now 8.00 a.m. What was the time 10 hours ago?

QUESTION 44

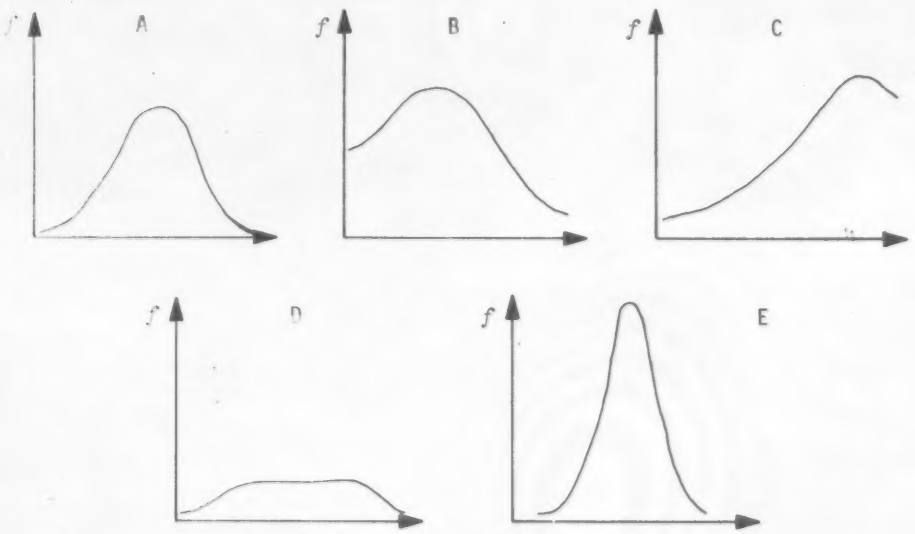
This graph compares athletes' running ability and their ability to throw the discus.



Draw, by eye, the regression line for this graph.

QUESTION 45

If the scale on each of the following graphs is the same, which one, A, B, C, D or E, shows a distribution with the smallest standard deviation?



165

Ans. _____

QUESTIONS 46 to 48 refer to the following information.

The cost price of a refrigerator to a retailer is K270.
The retailer makes a normal profit of K70.

QUESTION 46

Find the normal profit as a percentage of the cost price.

QUESTION 47

The refrigerator was damaged in a fire.
The normal profit was reduced by 30%.
Find the new profit to the nearest toea.

QUESTION 48

What was the selling price for the damaged refrigerator?

QUESTION 49

Simplify $\frac{6}{2}$

QUESTION 50

There are three children in a family.
What is the probability that there are 2 girls and 1 boy?

END OF EXAMINATION

DEPARTMENT OF EDUCATION

GRADE 12 EXAMINATION – 1981

MATHEMATICS (MINOR)

Paper 2

Examination Time: 2 hours

Name: _____

Number: _____

School: _____

INSTRUCTIONS TO CANDIDATES

1. There are 6 questions in this paper. Marks for each question are shown in brackets.
   Total: 50 marks.
   Answer ALL questions.

2. You will be supplied with 4-figure tables.
   Calculators may be used.

3. Write your answer to each question in the space provided, and **ALWAYS** show your working.

4. You will need mathematical drawing instruments for some questions.

DO NOT TURN OVER AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.

QUESTION 1

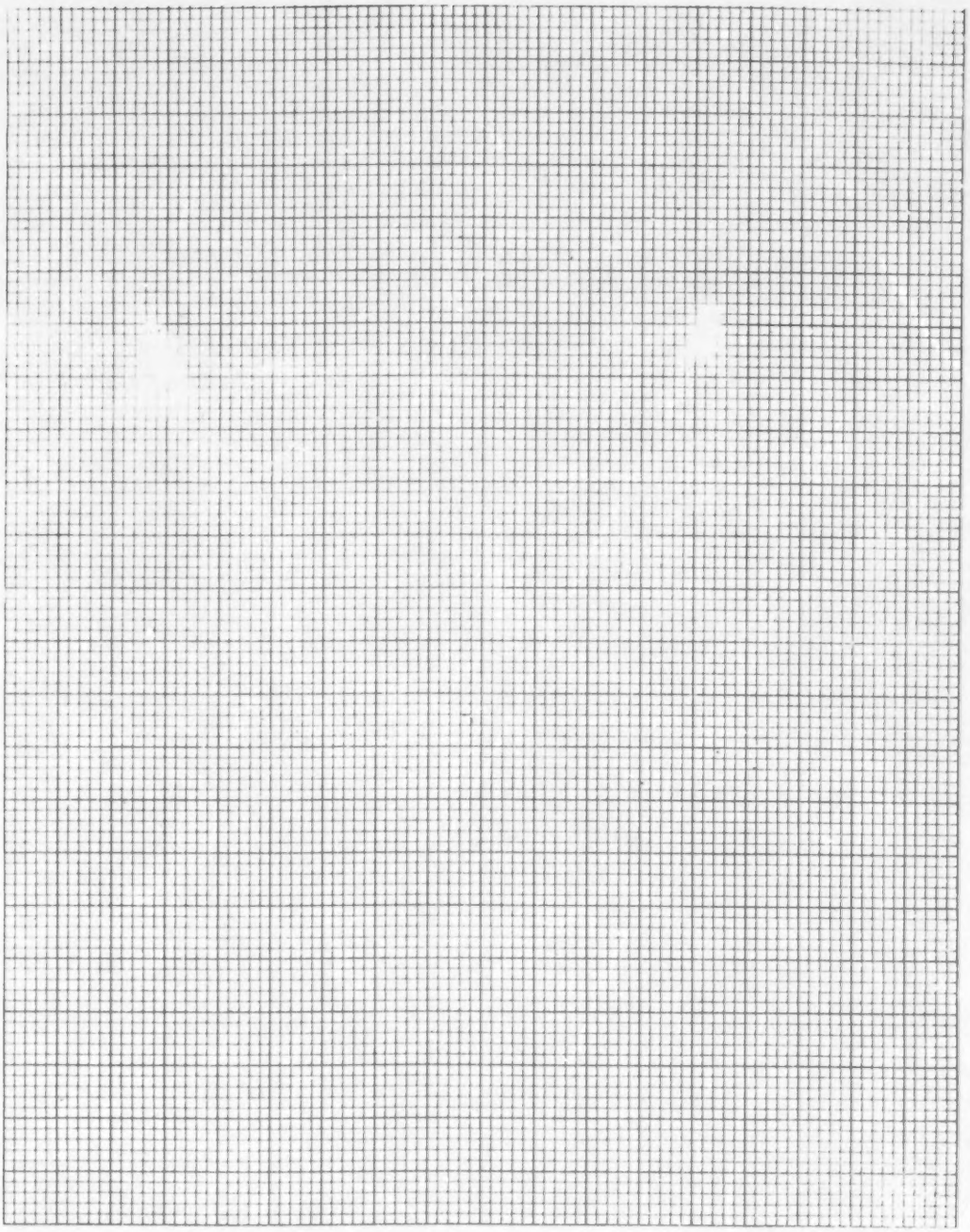
A party of explorers starts out across some dry bush country carrying 25 litres of water, which is used at the rate of 3 litres per day.

(a) Draw a graph on the page opposite, showing the number of litres (y) that remain after 'x' days for $x \leq 10$. (5 marks)

(b) What is the value of the 'x' intercept? (1 mark)

(c) What meaning does the 'x' intercept have in terms of days and litres of water? (1 mark)

(d) What units does the gradient have? (1 mark)



QUESTION 2

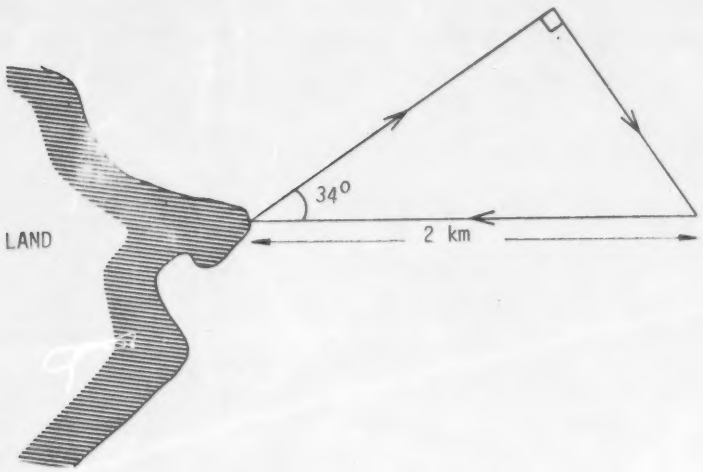
Two ships leave the same port at the same time, travelling in different directions. The first sails due south at 20 km/h. The other sets out at a bearing of 100^0 at 25 km/h.

(a) Show the paths of the ships and their positions after 2 hours on a scale drawing. State the scale you use. (5 marks)

(b) Use your drawing to find how far apart the ships are after 2 hours? (2 marks)

QUESTION 3

A boat sails over the following course:
(This is a sketch diagram)



Calculate how far the boat sailed. (5 marks)

QUESTION 4

In an experiment to check on the progress of trees, leaf areas were measured in square centimetres.
The following data were obtained:

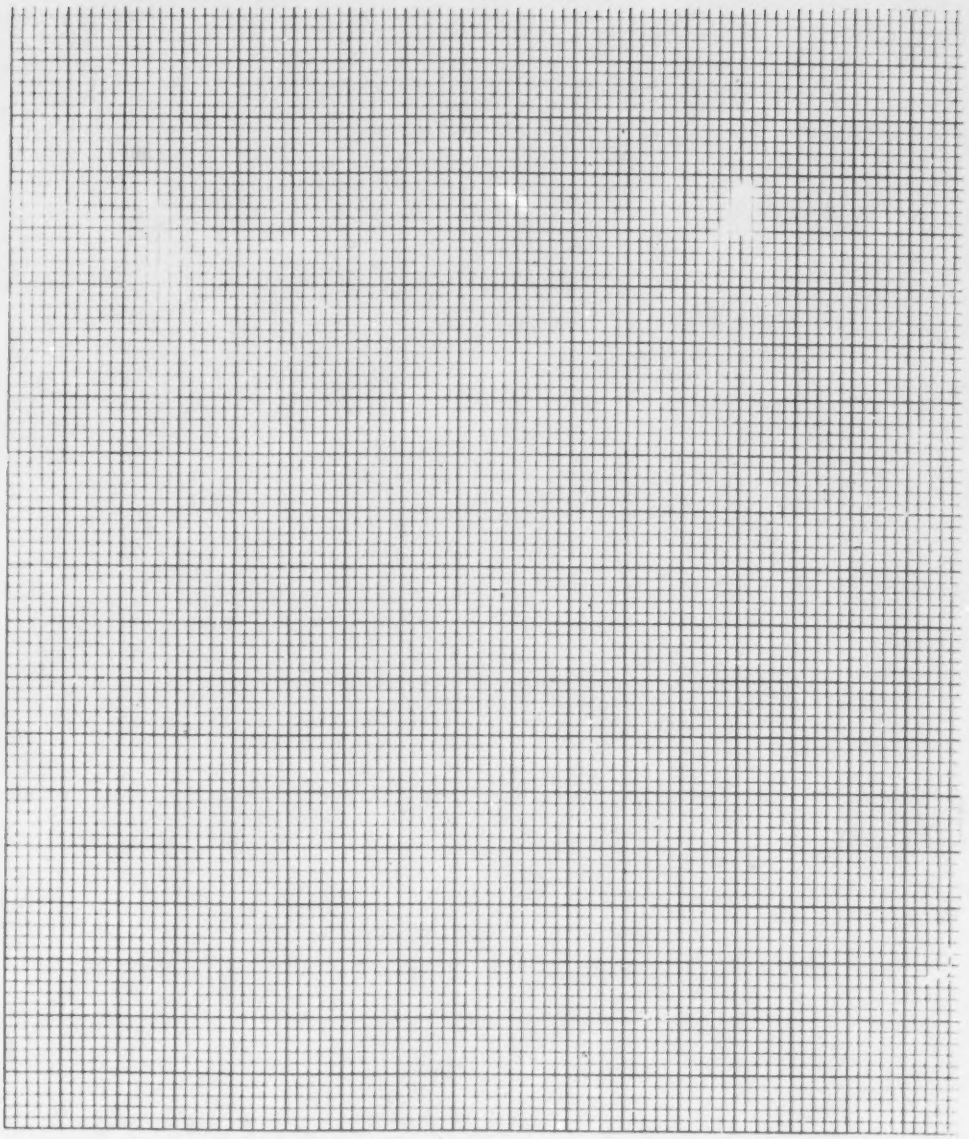
47	72	53	64	58	79	62	68	55	45	66	70
64	75	59	48	63	42	50	78	44	67	59	60
46	79	68	72	57	58	64	58	61	55	59	80

(a) Find the range of the data. (1 mark)

(b) Using class intervals like 50-54, 55-59, make a frequency table for the data. (4 marks)

(c) Which is the median class? (1 mark)

(d) Draw a histogram of the data. (4 marks)



QUESTION 5

You had K500 to invest. You had two options:

Option (i):

You could invest the K500 at 8% per annum compound interest for 4 years, or

Option (ii):

You could invest the K500 at 7% per annum simple interest for 5 years.

Calculate the amount you would have from each option and find the difference between the final total amounts. (9 marks)

QUESTION 6

(a) A telephone subscriber is charged a rental of 'R' kina each month. He also must pay 'm' kina for each call he makes. In one month he makes 'n' calls, and his total bill for that month is 'A' kina.

(i) Write doen a formula expressing 'A' in terms of 'R', 'n' and 'm'.

(3 marks)

(ii) One subscriber made 375 calls in October and his bill was K41.00. Another subscriber made 500 calls and his bill was K51.00.

Find the value of 'm', i.e. the cost of one phone call.

(b) The surface area of a rectangular box is given by

$$A = 2(lw + wh + lh)$$

and its volume is

$$V = l\,w\,h$$

Where l is the length of the box,
w is the width of the box, and
h is the height of the box.

A rectangular block of carbon 10 cm by 8 cm by 4 cm is cut into 1 cm cubes.

(i) What is the surface area of the original block?

(1 mark)

(ii) How many 1 cm cubes are obtained?

(1 mark)

(iii) What is the total surface area after cutting?

(2 marks)

The following M.E.C. Reports have been published:

No. 1: A. EDWARD 'Report for 1978, including a Short History of the Mathematics Learning Project and Mathematics Education Centre up to 1977', 1978.

No. 2: A.J. BISHOP 'Spatial Abilities in a Papua New Guinea Context', 1978.

No. 3: C. MEEK and N. FERIL 'A Pilot Study into the Level of Comprehension of Some Words taken from the Papua New Guinea Community Schools Mathematics Syllabus', 1978.

No. 4: A.J. BISHOP 'Developing Spatial Abilities', 1977.

No. 5: A. EDWARDS 'A Study of the Issues Involved in Establishing the Mathematics Education Centre and a Report on its Work from December 1978 to May 1979', 1979.

No. 6: A. EDWARDS and A. BAJPAI 'Preliminary Report on the Basic Arithmetic Test Carried out in Post-Secondary Institutions in Papua New Guinea in 1979', 1979 (out of print).

No. 7: A. EDWARDS 'Final Report on the Establishment of the Mathematics Education Centre', 1979 (out of print).

No. 8: G.A. LEAN 'The Training of Spatial Abilities: A Bibliograph', 1980.

No. 9: G.A. LEAN 'An Investigation of Spatial Ability Among Papua New Guinea Students', 1980.

No. 10: G.A. LEAN and M.A. CLEMENTS 'Spatial Ability, Visual Imagery and Mathematical Performance', 1980.

No. 11: P.L. JONES 'The Introductory Mathematics Programme at the Papua New Guinea University of Technology - A Survey of Student Opinion', 1980.

No. 12: P.L. JONES 'A Study of Proportional Reasoning', 1980.

No. 13: M.A. CLEMENTS and G.A. LEAN 'Influences on Mathematical Learning in Papua New Guinea: Some Cross - Cultural Perspectives' 1981, (2nd edition).

No. 14: M.A. CLEMENTS 'Careless Errors Made by Sixth-Grade Children on Written Mathematical Tasks', 1981 (2nd edition).

No. 15: P. SULLIVAN 'The Standards Debate: An Alternate Strategy', 1981.

No. 16: P.L. JONES 'Mathematical Language and the Learning of Mathematics in Papua New Guinea', 1981.

No. 17: F. AUSBURN and L. AUSBURN 'Perception, Imagery and Education in Developing Countries', 1981.

No. 18: M.A. CLEMENTS and P.L. JONES 'The Education of Atawe', 1981.

No. 19: P.L. JONES 'Learning Mathematics in a Second Language: A Problem with More and Less', 1981.

No. 20: M. SIFORD 'A Study of Algebra in the Provincial High Schools Curriculum', 1981.

No. 21: F. AUSBURN and L. AUSBURN 'Cognitive Styles and Visual Skills in Papua New Guinea Students', 1982.

No. 22: P.C. CLARKSON 'Mathematics Learning in PNG National High Schools: The Analytic - Visual Variable', 1982.

No. 23: P.C. CLARKSON 'Mathematics Learning in PNG National High Schools: A Comparison of Years 11 and 12 Across Schools', 1982.

No. 24: P. SULLIVAN 'Practical Aspects of Drug Calculations', 1982.

The following M.E.C. Technical Reports have been published:

No. 1: P. SULLIVAN 'Report of the First Conference to Prepare Mathematics Material for Post-Secondary Courses', 1981.

No. 2: P.C. CLARKSON 'Report of the 1980 National High School Year 12 Mathematics Marking Panel', 1981.

No. 3: 'Annual Report, 1980', 1981.

No. 4: 'Annual Report, 1981', 1982.

No. 5: P.C. CLARKSON 'Report on the 1981 National High School Year 12 Mathematics Examinations', 1982.

No. 6: P.C. CLARKSON 'Pre-University Mathematics Course', 1982.

No. 7: P. SULLIVAN 'Report of Second Program to Prepare Mathematics Materials for Post-Secondary Courses', 1982.

Other publications include:

P. SULLIVAN 'An Introduction to Nursing Mathematics', 1981.

P.C. CLARKSON (ed) 'Research in Mathematics Education in Papua New Guinea, 1981', Proceeding of the First National Conference on Mathematics Education, May, 1981.

P.C. CLARKSON and P. SULLIVAN 'Vocational Mathematics', 1982.

P.C. CLARKSON (ed) 'Research in Mathematics Education in Papua New Guinea, 1982', Proceedings of the Second National Conference on Mathematics Education, May, 1982.